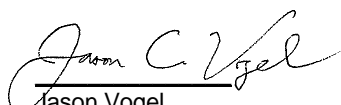


Haile Gold Mine, Inc.

**Spring 2012 Aquatic Resource
Surveys Report**

June 19, 2012




Jason Vogel
Senior Scientist

Penny Hunter
Senior Scientist

Haile Gold Mine Site

Spring 2012 Aquatic Resource Surveys Report

Prepared for:
Haile Gold Mine, Inc.

Prepared by:
ARCADIS U.S., Inc.
1687 Cole Blvd.
Suite 200
Lakewood
Colorado 80401
Tel 303.231.9115
Fax 303.231.9571

Our Ref.:
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- B Spring 2012 Aquatic Habitat Assessment Field Notes and Photographs
- C Spring 2012 Resident Fish Community Species Field Notes and Photographs



Abbreviations and Acronyms

AES	Alderman Environmental Services, Inc.
amsl	above mean sea level
ARCADIS	ARCADIS U.S., Inc.
BC	Buffalo Creek
CB	Camp Branch
Corps	US Army Corps of Engineers
CPOM	Coarse Particulate Organic Matter
CPUE	catch-per unit effort
DO	dissolved oxygen
EIS	Environmental Impact Statement
F	Fahrenheit
ft	feet
ft ²	square feet
ft/s	feet per second
FPOM	Fine Particulate Organic Matter
FWD	Fine Woody Debris
GPS	global positioning system
Haile	Haile Gold Mine, Inc.
HGMC	Haile Gold Mine Creek
HUC	Hydrolic Unit Code
Hwy	Highway
LLR	Little Lynches River
LWD	Large Woody Debris
mi ²	square mile
NCDENR	North Carolina Department of Environment and Natural Resources
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
ppm	parts per million
RBP	Rapid Bioassessment Protocol



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Romarco	Romarco Minerals, Inc.
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCSA	South Carolina Stream Assessment
Site	Haile Gold Mine
SOP	Standard Operating Procedure
TDS	Total Dissolved Solids
US	United States
USEPA	United States Environmental Protection Agency
UT	Unnamed Tributary
YOY	young-of-year

1. Introduction

1.1 Report Framework

This report details the results of the spring 2012 aquatic resource surveys performed in support of the Haile Gold Mine permitting, including the Environmental Impact Statement (EIS) being prepared by the US Army Corps of Engineers (Corps). The aquatic resource surveys conducted and described in this report include:

- spring 2012 Migratory fish study (Section 2);
- spring 2012 Aquatic habitat assessments (Section 3); Resident fish community surveys (Section 4); and
- Benthic macroinvertebrate surveys (Section 5).

1.2 Overview of Study Area

The Haile Gold Mine (Site) is located in Lancaster County, South Carolina (Latitude 34.579810° North, Longitude -80.539554° West). The permit boundary, defined as the land to be used for mining purposes that is shown in the 404/401¹ permit application pending before the Corps, consists of approximately 4,224 acres of privately owned land, bisected by Highway (Hwy) 601. The additional properties surrounding the permit boundary encompasses approximately 1,020 additional acres, and is property owned by Haile that is in the vicinity of the project. The permit boundary and property boundaries are shown in Figure 1-1. These two boundaries are collectively referred to in this report as “the Site.”

The Haile Gold Mine is located within the Piedmont and Coastal Plains ecobasins. The elevation at the site ranges from approximately 525 ft amsl, northeast of the site, to less than 350 ft amsl at the confluence between Haile Gold Mine Creek (HGMC) and the Little Lynches River. Further information about these stream conditions are presented in detail in the *Aquatic Resource Study Plan* (ARCADIS 2011) and the *Baseline Comprehensive Wildlife and Aquatic Resources Report* (ARCADIS 2012a).

¹ Joint Federal and State Application for Activities Affecting Waters of the United States for Critical Areas of the State of South Carolina (404/401 coverage).

2. Migratory Fish Study

This section presents the results of the spring 2012 migratory fish survey which was completed over two sampling events (Event 1 – March 27th to March 31st and Event 2 – April 16th to April 19th). The objective of the survey was to characterize baseline presence/absence of anadromous, diadromous and catadromous fish species (collectively “migratory” species) in the Little Lynches River near the Site as proposed in the *Migratory Fish Study Plan* (ARCADIS 2012b). Anadromous fish are those species that migrate from saltwater to freshwater to spawn (e.g., striped bass [*Morone saxatilis*]). Diadromous fish are those species that migrate between saltwater and freshwater during their life span (e.g., American and hickory shad [*Alosa sapidissima* and *Alosa mediocris*]). Catadromous fish are those species that migrate from freshwater to saltwater to spawn (e.g., American eel [*Anguilla rostrata*]).

2.1 Scope of Work

The Little Lynches River was selected to be surveyed for the presence of migratory fish because of all the stream systems at or immediately adjacent to the Site, the Little Lynches contains the most potentially suitable habitat, such as flow conditions and microhabitat variability that would be conducive to migratory fish passage or spawning (ARCADIS 2012b). Additionally, fish migration into tributaries within the Site boundaries would occur via the Little Lynches River.

Survey reaches were established within the Little Lynches River to cover areas of suitable and diverse habitat for potential migratory fish occurrence. As specified in the Study Plan, a minimum of 700 ft of stream was targeted for each survey reach within the Little Lynches River. Three survey reaches were established within the Little Lynches River to cover areas of suitable and diverse habitat for potential migratory fish occurrence (i.e. riffles, runs, and pools). An effort was made to select reaches with at least some areas of deeper water where migratory fish may stage, and the reaches were placed within natural boundaries (i.e. bound by shallow riffles on either end, or at structural barriers, such as at MFS-1 where a sheet pile dam is thought to preclude migratory fish passage above that point). Based on these factors, survey reaches were reduced slightly and the survey reaches in the Little Lynches averaged approximately 510 feet.

At each of the Little Lynches River locations, the use of three collection methods were employed to potentially collect migratory fish species. These methods included the

placement of a fyke net and 10 eel pots within each reach, along with conducting a set of three electrofishing survey passes (one per day) within each reach.

During the first day of the first survey event, an American eel (a target migratory species) was observed in the Little Lynches River. In response to this observation, the original scope of work was modified to include three additional locations (one site each in Camp Branch, Champion Branch, and Haile Gold Mine Creek). Since these locations were not part of the original scope, additional survey equipment (i.e., fyke nets and eel pots) was not immediately available. Hence, a decision was made to focus on surveying the three additional locations using backpack electrofishing, the most effective methodology available. It is noted that the American eel was detected only using backpack electroshocking equipment during the surveys.

Within each tributary location, a stream survey reach of approximately 328 ft was established to conduct the backpack electrofishing surveys. During the first survey event, each of the three tributary locations were surveyed twice using backpack electrofishing equipment. The decision to do so was based on the timing of the decision and extent of the first survey event. During the second survey event, all three locations were surveyed three times with backpack electrofishing to coincide with the level of effort performed on the original three survey locations conducted within the Little Lynches River.

2.2 Study Locations

Six locations were surveyed during the spring 2012 migratory fish survey, three from the Little Lynches River (MFS1 – MFS3 as proposed in the original scope of work [ARCADIS 2012b]), and one each from within Camp Branch, Champion Branch, and Haile Gold Mine Creek (MFS4 – MFS6). Table 2-1 presents the coordinates and approximate reach length of each location and Figure 2-1 shows the locations of six migratory fish survey locations. Descriptions of each study location are presented below.

- MFS1 the most upstream location in the Little Lynches River, terminating at a sheet-pile check dam. This location was selected based on the presence of this in-stream barrier which is thought to prevent migratory fish passage upstream. The total reach length surveyed was approximately 504 ft.
- MFS2 is located within the Little Lynches River just downstream of Ned's Creek confluence. This location was selected based on the presence of high

quality habitat (i.e. potential spawning gravel) that may support the target species. The total reach length surveyed was approximately 561 ft.

- MFS3 is located within the Little Lynches River downstream of Gates Ford Branch. This location is the most downstream extent of the Little Lynches River surveyed. The total reach length surveyed was approximately 467 ft.
- MFS4 is located within the Haile Gold Mine Creek upstream of the Little Lynches River confluence. The total reach length surveyed was approximately 290 ft.
- MFS5 is located within Champion Branch upstream of the Little Lynches River confluence. The total reach length surveyed was approximately 294 ft.
- MFS6 is located within Camp Branch upstream of the Little Lynches River confluence. The total reach length surveyed was approximately 393 ft.

2.3 Survey Equipment and Methods

Fish surveys were conducted qualitatively and quantitatively by a crew of ARCADIS and AES trained biologists at the locations previously described. Dates of the events are: Event 1: March 27th to March 31st, 2012; and Event 2: April 16th to April 19th, 2012. Prior to the start of each survey, a representative location within each study reach was selected to measure stream flow using a Marsh-McBirneyTM flow meter and water quality parameters (temperature, pH, specific conductivity, turbidity, dissolved oxygen and total dissolved solids [second sampling event only]) using a YSI 650 MDSTM multi-parameter water quality meter. During the second survey event, a rainfall event occurred during the afternoon and evening of April 18th. A second set of water quality measurements were therefore taken at each of the original three surveyed locations to determine if the rainfall had any short-term impact on water quality. Stream flow and water quality parameter measurements are presented in Table 2-2. It was determined that the rainfall event did not have any short-term impact on water quality.

Migratory fish surveys followed the standard operating procedure (SOP) described in *Migratory Fish Study Plan* (ARCADIS 2012b). Three collection methods were utilized within each study reach: 1) backpack electrofishing; 2) fyke netting; and 3) eel trapping. An overview of each survey method is described below.

- **Backpack Electrofishing** – During both survey events, one electrofishing pass was conducted at each location over an average reach length of approximately 510 ft in the Little Lynches River (MFS1 – MFS3) and approximately 330 ft in the tributaries to the Little Lynches River (MFS4 – MFS6). The electrofishing survey was conducted using two backpack units and two netters once per day at each of the original three locations (MFS 1-3) and using one backpack unit and two netters (due to the smaller stream size/width) at each of the three additional locations (MFS-4-6) for a total of three passes conducted during each survey event to avoid unnecessary trauma to the resident fish species. As mentioned previously in Section 2.2, locations MFS4 through MFS6 had electrofishing passes for two days during the first sampling event, based on the timing of the change in scope of work. Survey techniques were performed generally consistent with SCDNR protocols (Scott et al. 2011) and Rapid Bioassessment Protocols (RBPs) for wadeable streams (Barbour *et al.* 1999).

A survey crew of five biologists used Smith-Root backpack electrofishing units and two netters to collect target migratory fish species. Any migratory fish species observed were retained for length measurement and photographed prior to release. All observed migratory fish data obtained per study reach was recorded in the field notebook. Resident fish species were not collected during electrofishing to avoid any unnecessary trauma related to handling. A representative photo of electrofishing, showing the equipment used, is provided in Appendix A as Photo #1.

- **Fyke Netting** – During both survey events, a fyke (trap) net was set at locations MFS1 through MFS3 within the most suitable habitat (i.e. pool) for an overnight passive collection set. Fyke nets were not set at locations MFS4 through MFS6 because these locations were not part of the original study plan and electrofishing techniques would be the most effective means of collection in these smaller tributary creeks (ARCADIS 2012b). The fyke nets were placed in the same location in each reach during both survey events and were recorded with a handheld GPS unit and flagged to locate upon retrieval. Three overnight sets were used at each survey location and nets were checked and all retained organisms were released daily.

The fyke net consisted of two lead net wings that extended from the shoreline approximately on a 45 degree angle to an attached series of hoops with passage funnels that lead to an end bag. The series of hoops consisted of 5 to 7 individual frames that were 3 to 4 ft in diameter. The net mesh size for the lead nets and series of hoops was approximately 1 to 2 inches. A

representative photo of the fyke nets used, showing the placement technique, is provided in Appendix A as Photo #2.

All resident fish species and other aquatic biota caught such as turtles were recorded in the field notes and released from the nets daily.

- **Eel Trapping** – During both survey events, ten Gee[®] eel pot traps were set at locations MFS1 through MFS3 in suitable habitats throughout the reaches for overnight passive collection. Eel pots were not set at locations MFS4 through MFS6 because these locations were not part of the original study plan and electrofishing techniques would be the most effective means of collection in these smaller tributary creeks (ARCADIS 2012b). In addition, during the second survey event, three Fukui[®] PVC constructed tube traps were set at locations MFS1 through MFS3. Each trap location was recorded with a handheld GPS unit and flagged to locate upon retrieval. Three overnight sets were used at each survey location. Traps were baited prior to deployment and checked and re-baited each subsequent day.

The traps consisted of either an elongated standard Gee[®] galvanized steel minnow trap or a Fukui[®] PVC constructed tube trap. The Gee[®] trap measures approximately 9-inches in diameter by 31-inches in length and has a ¼-inch mesh, with two, 1- to 2-inch funneled openings. The Fukui[®] trap measures approximately 4¼- to 6-inches in diameter by 31-inches in length and has a ported tube, and two, 1- to 2-inch funneled openings. A representative photo of the Gee[®] eel trap is provided in Appendix A as Photo #3.

Resident fish species collected in the traps were noted and released from the traps daily.

2.4 Survey Results

The following section describes the general habitat conditions and discusses the results of the migratory fish surveys conducted during the spring 2012 migratory fish study. Observations of migratory fish species collected via the three survey methods, along with resident fish species observed as by-catch within the fyke nets and eel traps, are summarized below. Results by each study reach are presented in Table 2-3 and supporting field notes are provided in Appendix A.

- **MFS1** – This location in the Little Lynches River consisted primarily of slow-moving, shallow (typically less than 2-ft deep) water over a soft substrate with

occasional cobbles. The majority of the reach consisted of run habitat with the exception of a relatively large pool below the sheet pile check dam at the upstream extent of the reach (Appendix A - Photos #4 and #5). Water quality parameters are presented in Table 2-2.

In total, two American eels were observed at MFS-1 during the survey. Both eels were observed while electroshocking: one on the first day of the first survey event, and one on the second day of the second survey event (Table 2-3). The American eel observed during the first survey event measured 8.7-inches in length (Appendix A - Photo #6) and the American eel observed during the second survey event measured 11.7-inches in length (Appendix A - Photo #7). No migratory species were observed or collected in the eel traps or fyke nets. Resident fish collected as by-catch in the eel traps and fyke nets were noted, as presented in Table 2-3. This includes two SCDNR priority species, the greenfin shiner and flat bullhead.

- **MFS2** – This location in the Little Lynches River consisted primarily of slow to moderately moving, shallow (less than 2-ft deep) water with run and riffle habitat and one small pool in the middle of the reach. A mix of sand, gravel and cobble was the predominant substrate (Appendix A - Photos #8 and #9). Water quality parameters are presented in Table 2-2.

No migratory fish species were observed in MFS2 during either survey event with any method. Resident fish collected as by-catch in the eel traps and fyke nets were noted, as presented in Table 2-3. This includes three SCDNR priority species, the greenfin shiner, greenhead shiner and flat bullhead.

- **MFS3** – This location in the Little Lynches River consisted of slow-moving, deeper (approximately 2- to 4-ft deep) water with a mostly soft, sandy substrate (Appendix A - Photos #10 and #11). Water quality parameters for this location are presented in Table 2-2.

In total, five American eels were observed in MFS-3, one during the first event, and four during the second event (Table 2-3). All eels were observed/collected while electroshocking. The American eel observed during the first survey event measured 20.1-inches in length (Appendix A - Photo #12) and the American eels observed during the second survey event measured 19.8-, 13.8-, 20.1- and approximately 12-inches in length, respectively (Appendix A - Photos #13, #14 and #15). Note: the fourth American eel observed on the third day of the second survey event was not netted, so a photo is not available and the length

measurement is an estimate. Resident fish collected as by-catch in the eel traps and fyke nets were noted, as presented in Table 2-3. This included one SCDNR priority species, the flat bullhead.

- MFS4 – This location in Haile Gold Mine Creek consisted of shallow water (less than approximately 2-ft deep) with a sequence of riffles, runs, and pools (Appendix A - Photos #16 and #17). Water quality parameters are presented in Table 2-2. No migratory fish species were observed in either sampling event.
- MFS5 – This location in Champion Branch consisted of very shallow water (less than 3-inches deep) with soft substrates and organic debris (Appendix A - Photos #18 and #19). Water quality parameters are presented in Table 2-2. No migratory fish species were observed during either sampling event.
- MFS6 – This location in Camp Branch consisted of shallow water (less than 1-ft deep) with a sequence of riffles, runs, and small pools (Appendix A - Photos #20 and #21). Water quality parameters for this location are presented in Table 2-2. No migratory fish species were observed in either sampling event.

2.5 Migratory Fish Summary

- During the spring 2012 migratory fish survey, only the catadromous species (American eel) was observed at any of the survey locations. No other migratory fish species (e.g., American or hickory shad, and/or blueback herring) were observed. A total of seven American eels were observed during the study (2 at the most upstream location [MFS1], and five at the most downstream location [MFS3]) within the Little Lynches River. No American eels were observed in the small tributaries (i.e., Camp Branch, Champion Branch, and Haile Gold Mine Creek). The observed American eels ranged from 8.7- to 20.1-inches in length. Based on these sizes, the American eels are in their final inland resident stage of life as young to mature adult yellow eels (SCDNR 2005).
- All the American eels collected during the study were collected via electrofishing. The eel traps and fyke nets did not produce any migratory fish target species. Resident fish collected as by-catch in the fyke nets and eel traps set within the Little Lynches River were relatively abundant, as 20 species were observed during the study (Table 2-3). Amongst these species, three SCDNR priority species were observed (greenfin shiner, greenhead shiner and flat bullhead).

- Based on the results of the migratory fish study, it appears that although migratory fish are not abundant in the waterways in the vicinity of the site (only seven individuals from one species were observed); the catadromous American eel may use the Little Lynches River at least as a migratory corridor. No migratory fish species were observed in the three smaller tributaries (Haile Gold Mine Creek, Camp Branch, or Champion Branch) during the study. Observations of habitat conditions, and the negative survey results, suggest that these waterbodies do not provide significant habitat for migratory fish.

3. Spring 2012 Aquatic Habitat Assessments

The primary objective of the spring 2012 fish and aquatic habitat study is to characterize spatial baseline aquatic resources within and immediately adjacent to the Haile Gold Mine. The entire area that will be surveyed in spring 2012 is referred to in as “the study area.” Following the primary objective, the specific study objectives include the following:

- Characterize the presence, abundance and diversity of resident fish populations in streams within the study area.
- Characterize the presence and diversity of reptile and amphibian populations in streams within the study area.
- Measure springtime habitat conditions at survey locations.
- Verify the presence of Sandhills Chub at previously surveyed locations.

3.1 Sampling Methods for the Aquatic Habitat Assessment

Aquatic habitat assessments were conducted on April 3rd and April 5th, 2012, to support interpretation of aquatic species surveys. Locations of the survey are shown in Figure 3-1.

Habitat assessments at the new survey locations (new compared to fall 2011) were performed in the field by ARCADIS personnel following U.S. Environmental Protection Agency’s (USEPA) Rapid Bioassessment Protocol (RBP) for low gradient streams (Barbour et al 1999) and SCDNR’s Habitat Assessment Protocol (Scott et al 2011). Specific methods for the habitat assessment were described in detail in the *Aquatic Resources Study Plan spring 2012* “Study Plan” (ARCADIS 2012c). All methods described in the plan were followed during the assessment, except for the following departures:

1. SCDNR’s Stream Assessment Protocol includes methods for quantitative measures of substrate type, depth and flow velocity. The method involves traversing a random zig-zag transect along the length of the sample reach and recording depth, flow velocity and substrate measurements at 50 points. These measurements are used to understand habitat heterogeneity in flow velocity, depth and substrate types. Field crew applied this protocol at each

study location, but reduced the number of measurements to 25 in smaller tributaries due to the homogeneity of these parameters in these systems.

2. The Study Plan identified six aquatic study areas within two stream systems (Figure 3-1), including Camp Branch and HGMC. To overlap the previous survey reaches, several aspects of the habitat assessment methods were adjusted to meet the study objectives. For example, based on SCDNR' Stream Assessment Protocol, the siting of a reach should not be surveyed if it is naturally impounded (e.g., beaver activity), contains extensive channel braiding, if the channel is altered by a road crossing, or if it contains a tributary confluence. The upper location in Camp Branch (CB4) had segments of the channel, which were impounded by beaver activity, along with some minor braiding within the survey reach. Based on the previous survey point, the upper portion of location HGMC3 was sited just downstream of a road crossing culvert and included a very small (0.5 to 1 ft wide) tributary confluence. Location HGMC5, just upstream of the Leadbetter Reservoir, was sited between two existing beaver dam impounded sections of creek. The HGMC5 reach was shortened based on these channel obstructions; however it overlaps the previous survey location (R93-1).

Habitat assessments in the field included six locations, three within Camp Branch and three within Haile Gold Mine Creek. Previous stream reaches that were assessed in fall 2011 were not re-evaluated during this spring 2012 effort, because flow information collected during the spring 2012 resident fish community survey effort (ranges and maximum velocity measurements) showed that stream flows were up only very slightly (approximately 10%), compared to flow information at the same locations sampled in fall 2011. The flow difference between spring and fall did not alter overall habitat conditions, such that RBP scores for spring 2012 mirror that of previous surveys collected in the fall. The minimal habitat changes observed were not significant enough to cause changes in sampling protocols (i.e., equipment and personnel used per survey reach). Descriptions of the differences observed between spring and fall are described in the results section, and estimated RBP scores are provided.

Prior to initiating field surveys, field staff verified with Haile staff and local weather reports that no precipitation had occurred within 48 hours of field surveys, consistent with SCDNR recommendations.

USEPA's RBP includes an evaluation of 10 physical habitat parameters related to general land use, riparian vegetation features and in-stream parameters. These habitat parameters are scored through visual assessment of the quality of habitat structure based on RBP guidance and best professional judgment.

The RBP protocol also provides a relative rank for overall habitat quality (optimal, suboptimal, marginal and poor) based on scorings for specific habitat parameters. These ranks provide information on the overall quality and condition of in-stream and surrounding physical habitat. This information supplements data gathered from the concurrent biological sampling because the quality of habitat structure influences the condition of the resident aquatic community (Barbour et al. 1999).

Some of the stream habitats within the study area were assessed previously in support of a Compensation Mitigation Plan (ERC 2010). The procedure used in ERC (2010) is very similar to USEPA's RBP, the only significant difference being the ranking scale used for each of the 10 habitat parameters: the Compensation Plan protocol uses a two-point scale (e.g., 0-2) for each parameter while the RBP protocol uses a twenty-point scale (e.g., 0-20). The procedure also provides a relative rank for overall habitat quality (fully functional, partially impaired, impaired, and very impaired), similar to the RBP protocol. Thus, correcting for order of magnitude difference allowed for more direct comparability between results. The relative rank was used to generally compare results from the two studies, for stream segments that overlapped, or were spatially proximate, to study reaches described below.

3.2 Data Analysis Methods for the Aquatic Habitat Assessment

Aquatic habitat structure was evaluated qualitatively in the field. RBP habitat scores generated through this habitat assessment were used to make relative comparisons of habitat quality among sample locations. Physical measurements of wetted width, depth and flow were averaged over the length of each sampling reach. This information was used to supplement the biological sampling data and provide general descriptions of habitat structure and quality.

3.3 Results for the Aquatic Habitat Assessment

The following section describes the results of the habitat assessments conducted in spring 2012 to support fish surveys. Locations surveyed are shown in Figure 3-1. Tables 3-1 through 3-3 provide summaries of water quality parameters measured, measures of physical parameters per SCDNR protocol, and RBP scores and rank.

Inorganic substrate composition of each survey point is summarized in Figures 3-2 and 3-3. Substrate composition was determined through the evaluation of 25 sample points along the length of each survey reach. Field data sheets, notes and photo-documentation are provided in Appendix B. Results are described below by survey reach.

3.3.1 HGMC3

HGMC3 is located in the upper portion of HGMC, approximately 4,200 ft upstream of the Ledbetter Reservoir, and overlaps previous survey locations (R93-2 and SC11-HGM1A, respectively; see Figure 4-1). This survey point is located directly below a road crossing that consists of an approximately 2 to 3 ft diameter culvert.

The reach surveyed at HGMC3 consists of a mostly wetted channel and flowing water with an average flow velocity of 0.72 ft/s and an average depth of 0.36 ft on the day of the assessment (4/5/2012). Baseflow and the corresponding wetted width reached the edge of banks throughout most of the reach. Minimal exposed substrate was observed. Stream morphology of this reach was represented by approximately 60% run habitat and 40% pool habitat. All pool habitats were characterized as small-shallow according to guidelines presented in Barbour et al. (1999).

Upland areas adjacent to the drainage were recently logged, but a riparian buffer approximately 60 to 250 ft wide exists throughout most of the sample reach, surrounding the channel. The channel is mostly shaded (approximately 85% shaded) and the dominant riparian tree species consisted of American Holly, Sweetgum, Red Maple, and Tulip Poplar. Channel banks on each side of the surveyed reach were stable with dense vegetation, and there was no evidence of bank erosion or failure. No species of aquatic vegetation (including periphyton) were observed within the channel. No channel alterations, including channelization or dredging, were evident within this survey reach.

The inorganic substrate is composed primarily of a sandy-silt (approximately 24% sand, 16% silt) with some gravel (Figure 3-2). Coarse particulate organic matter (CPOM) and fine and large woody debris (FWD, LWD) were relatively abundant throughout the sample reach and were estimated to cover approximately 28% and 8% of the channel bottom respectively. LWD estimate for this reach ($1 \times 10^6 \text{ ft}^2/\text{mi}^2$) was among the highest values recorded during the spring habitat survey.

A total RBP score of 152 (suboptimal) was determined for HGMC3, which is consistent with the findings reported by ERC (2010), for location R-HR-17. Both sets of scores show an RBP rank of “partially impaired” for this reach.

3.3.2 HGMC4

HGMC4 is located in the upper portion of HGMC, approximately 1,500 ft upstream of the Ledbetter Reservoir, and overlaps with a previous survey location (R08-3; see Figure 4-1). Between the reservoir and HGMC4 exists a road crossing (approximately 600 ft downstream of HGMC4), and two beaver dams near to HGMC5. On the day of the assessment (4/5/2011), average flow velocity was 0.68 feet per second (ft/s) and average depth was 0.92 ft. Baseflow and the corresponding wetted width (6.1 ft) reached the edge of banks throughout most of the reach. Minimal exposed substrate was observed. Stream morphology of this reach consisted of nearly all run habitat. The reach observed was within an incised channel with relatively uniform width and depth.

The channel inorganic substrate is composed primarily of sandy-silt (approximately 24% sand and 16% silt) with some gravel (24%) (Figure 3-2). LWD, undercut banks and root mats, were mostly absent within this reach. LWD estimates determined at HGMC4 were low compared to other reaches ($3.1 \times 10^5 \text{ ft}^2/\text{mi}^2$). Moderate deposits of sand were observed within this sample reach, and the marginal increases in bar formation observed were composed primarily of gravel. Within the shallow pool habitats, sediment deposition was minimal.

The left overbank area had portions within the reach that were less than 59 feet, but the remaining riparian vegetative zone width was greater than 59 feet on each side of the channel. The dominant species of riparian vegetation consisted of mostly young trees, shrubs, and grasses; including: Red Maple, Blackberry, Netted Chain Fern, and Giant Cane. Channel banks on each side are densely vegetated with young trees, shrubs, non-woody macrophytes and herbaceous ground cover providing optimal bank stability, and impart a partially open canopy (approximately 65% shaded). No signs of channel alteration, including channelization or dredging, were observed. A moderate amount of filamentous algae was observed throughout this sample reach, and was visually estimated to cover 30% of the available substrate. Filamentous algae, along with two species of aquatic vegetation (*Juncus sp.*, *Sparganium americanum*) were the only types of aquatic vegetation observed in this reach.

A total RBP score of 148 (suboptimal) was determined for HGMC4, which is consistent with the findings reported by ERC (2010), at location R-HR-15. Both assessments rank this reach “partially impaired”.

3.3.3 HGMC5

HGMC5 is located in the upper portion of HGMC, just upstream (approximately 200 ft) of the Ledbetter Reservoir, and overlaps a previous survey location Rohde (R93-1; see Figure 4-1). This reach was impounded due to beaver activity, which formed a shortened reach of approximately 174 ft in between a set of dams with an average wetted width of 15.4 ft. On the day of the assessment (4/5/2011), average flow velocity was 0.46 feet per second (ft/s) and average depth was 1.8 ft. Baseflow and the corresponding wetted width reached the edge of banks throughout the entire reach. Minimal exposed substrate was observed. Stream morphology of this reach was primarily pool habitat (65%) due to beaver activity with run habitat below the upstream dam accounting for the remaining 35%.

As shown in Figure 3-2, the channel inorganic substrate is composed primarily of silt (43%). LWD, undercut banks, and root mats, were mostly absent within this reach. LWD estimates determined at HGMC5 were moderate as compared to other reaches ($5.3 \times 10^5 \text{ ft}^2/\text{mi}^2$). CPOM, FWD, LWD, and aquatic vegetation were relatively abundant throughout the sample reach and were estimated to cover approximately 21%, 21%, and 14% of the channel bottom respectively.

The riparian vegetative zone width was greater than 59 ft on each side of the channel. The dominant species of riparian vegetation consisted of trees, shrubs, and grasses; including Red Maple, Sweetgum, Tag Alder, Blackberry, and Giant Cane. Channel banks on each side are densely vegetated with some young trees, shrubs, non-woody macrophytes and herbaceous ground cover providing optimal bank stability, and impart a more open canopy with partial shading (approximately 45% shaded). No signs of channel alteration, including channelization or dredging, were observed. An abundance of aquatic vegetation and filamentous algae was observed throughout this sample reach, and was visually estimated to cover 60% of the available substrate. Periphyton, along with four species of aquatic vegetation (*Juncus sp.*, *Sparganium americanum*, and two species of *Carex spp.*) was observed in this reach.

A total RBP score of 144 (suboptimal) was determined for HGMC5, which is consistent with the findings reported by ERC (2010) as “partially impaired” for this section of creek (R-HR-15) surveyed.

3.3.4 Upper HGMC Reaches

HGMC1 and HGMC2 were assessed in fall 2011 for habitat quality (ARCADIS 2012a). A total RBP score of 118 (suboptimal) was determined for HGMC1, which is consistent with the total score of 125 (scaled up by an order of magnitude to account for differences in ranking scale) reported by ERC (2010) for the closest downstream location (R-HR-17) surveyed. For HGMC2, a total RBP score of 126 (suboptimal) was determined, which is consistent with the total score of 120 (scaled up by an order of magnitude to account for differences in ranking scale) reported by ERC (2010) for the same location.

During the spring surveys, flows were about 10% higher in both the upper (HGMC1) and lower (HGMC2) portions of HGMC compared to fall 2011. The channels are confined in these reaches, such that the wetted width was not noticeably different than fall conditions. Velocities measured in spring were similar to fall conditions (Table 3-2). Estimated springtime RBP rank for these locations, based on these observations, would remain as suboptimal.

3.3.5 CB3

The lowest Camp Branch location, CB3, was assessed in fall 2011 for habitat quality (ARCADIS 2012a). It is located approximately 0.62 miles upgradient of the Little Lynches River confluence in a relatively higher gradient section of the stream. A total RBP score of 129 (suboptimal) was determined for CB3, which is the highest score of the Camp Branch reaches assessed. Increased functional epifaunal substrate and bank stability were the primary factors contributing to the higher RBP score. In spring 2012, water depths had increased slightly compare to the fall, with the effect that less riffle substrate was exposed in the spring. Wetted widths were not observed to be different than fall conditions, due to the confined nature of the channel, and flow velocities were comparable. Estimated springtime RBP rank for this location, based on these observations, would remain as suboptimal.

3.3.6 CB4

CB4 is located near the headwaters of Camp Branch on the main fork of the drainage, and overlaps a previously surveyed location (R10-4; see Figure 4-1). This reach is just below a beaver dam, and contained two smaller beaver dams within the survey reach. On the day of the assessment (4/3/2012), the average wetted width was 11.1 ft and the survey reach length was 328 ft. The average depth of the reach was 0.66 ft and the

average flow velocity was 0.79 ft/s. The channel is mostly shaded with an estimated 70% canopy cover. The riparian vegetative zone width was greater than 59 ft on the sides of both channel banks. No channel alterations were observed within this reach; although some braiding has occurred due to presence of beaver dams. Adjacent uplands are densely vegetated and dominant species consists of Red Maple, Tag Alder, Water Oak, and American Elm. Channel banks are protected and stable, given the dense coverage by trees, understory shrubs and grasses.

Channel inorganic substrate is composed primarily of sandy-silt (approximately 24% sand and 24% silt) (Figure 3-3). An abundance of CPOM (32%), including leaf litter and sticks, was also present in the stream reach. LWD was moderately abundant, with an estimated LWD density ($4.7 \times 10^5 \text{ ft}^2/\text{mile}^2$). Shallow run (50%) and pool (50%) habitats were the major stream morphology types observed within this reach. During the habitat assessment, baseflow was low to moderate (on average, water filled only about 75% of the available channel). As a result, some substrates were exposed. Four species of aquatic vegetation were observed including *Murdannia kiesak* and *Sparganium americanum*. In addition, a small amount of green filamentous algae was observed on the substrate. Aquatic vegetation occurred within approximately 4% of the reach.

A total RBP score of 143 (suboptimal) was determined for CB4, which is comparable with the findings by ERC (2010) as “partially impaired” for locations in Camp Branch adjacent to the CB4 reach.

3.3.7 CB5

The CB5 reach and overlaps a previously surveyed location (R10-2; see Figure 4-1), and is just downstream of a beaver dam, which separates this reach from the upstream CB4 reach. The average wetted width was 5.7 ft and the survey reach length was 328 ft. On the day of the assessment (4/3/2012), the average depth was 0.39 ft and the average flow velocity was 0.67 ft/s. Water within the reach filled about 75% of the available channel and resulted in some exposed riffle substrates. Shallow runs composed the majority (about 60%) of the stream morphology with 30% shallow pools and 10% riffles. Most of the pools were poorly defined as a result of low baseflow conditions, and were characterized as small–shallow pools with substrate composed primarily of sand and silts. Inorganic substrate type consisted mostly of gravel (20%) and sand (20%) and smaller proportions of cobbles (12%), silt (12%), boulders (8%), and clay (8%). LWD was moderate, with an estimated LWD density ($3.3 \times 10^4 \text{ ft}^2/\text{mile}^2$). Organic substrates included small portions of CPOM and fine particulate organic

matter (FPOM) (a combined 16%) and aquatic vegetation (Figure 3-3). Four species of aquatic vegetation were observed including *Murdannia kiesak* and *Sparganium americanum*. In addition, a small amount of green filamentous algae was observed on the substrate. Aquatic vegetation occurred within approximately 30% of the reach.

Portions of the adjacent uplands in the right overbank area are former maintained food plots that are now early successional fields, with evidence of some localized erosion and a riparian vegetative zone width less than 59 ft. The canopy cover is partly open with approximately 15 – 30% shade, averaged over the length of the sampling reach. Dominant riparian species include small trees and shrubs including: Kudzu, Elderberry, and Red Maple.

Channelization or other forms of channel alteration were not observed within the sample reach. Moderate deposition of sand and FPOM were observed on old and new bar formations, on meanders and in shallow pools. Channel banks were characterized as moderately unstable, with about 30% of eroded channel banks and areas bank failure evident throughout the reach.

A total RBP score of 122 (suboptimal) was determined for CB5, which is among the lowest scores of the Camp Branch reaches assessed.

3.3.8 CB6

The CB6 was located between the CB1 and CB2 reaches and overlaps a previously surveyed location (R10-6; see Figure 4-1). The average wetted width was 8.9 ft and the survey reach length was 328 ft. On the day of the assessment (4/3/2012), the average depth was 0.47 ft and the average flow velocity was 0.89 ft/s. At the time of the survey about 75% of the available channel was wet which resulted in some exposed riffle substrates. Shallow runs composed the majority (about 60%) of the stream morphology types with 24% riffles and 16% shallow pools. Most of the pools were poorly defined as a result of low baseflow conditions, and were characterized as small–shallow pools with substrate composed primarily of sand and silts. Inorganic substrate type consisted mostly of gravel (32%) and sand (20%) and smaller proportions of boulders (8%), bedrock (8%) and clay (4%). LWD was abundant, with an estimated LWD density (1.3×10^6 ft²/mile²). Organic substrates included small portions of CPOM (16%) and aquatic vegetation (4%) (Figure 3-3). Three aquatic vegetation species (*Sparganium americanum*, *Murdannia kiesak*, and *Juncus* sp.) were observed in this reach including a small amount of green filamentous algae on the substrate.

Aquatic vegetation was relatively sparse and occurred within less than 5% of the reach.

Channelization or other forms of channel alteration were not observed within the sample reach. Slight deposits of silt were observed in the bottom of one pool, but otherwise depositional areas were largely absent. Channel banks were characterized as moderately unstable, with about 30% of channel banks eroded and areas of bank failure evident throughout the reach.

The riparian vegetative zone was greater than 59 feet on both overbank areas, and no signs of anthropogenic disturbance was observed. Riparian vegetation was dominated by young to mature trees and consisted of American Elm, Tulip Poplar, Red Maple, and Sweetgum, which provided a mostly shaded channel canopy (approximately 80 to 90% shaded).

A total RBP score of 140 (suboptimal) was determined for CB6. Increased functional epifaunal substrate and pool substrate were the primary factors contributing to the higher RBP score.

3.3.9 Little Lynches River

Reaches LLR1, LLR2, LLR4 and LLR6 were assessed for habitat quality in fall 2011 (ARCADIS 2012a). During spring fish surveys, the wetted width and depths observed at LLR1 and LLR2 increased marginally, and more contiguous habitat was observed between runs and shallow pools than what was observed the previous fall. The downstream LLR reaches (LLR4 and LLR6) did not show any observable changes, possibly due to the influence of the upstream barrier (i.e., the sheet-pile dam) below LLR2. Velocities measured in spring were similar to fall conditions (Table 3-2).

RBP scores for reaches LLR1, LLR2 and LLR3 ranged from 110 to 115, all ranked as suboptimal. Increased bank stability was the primary factor contributing to the higher RBP score. Estimated springtime RBP rank for these locations, based on these observations, would remain as suboptimal. LLR6 was evaluated in the fall 2011 and had a RBP score of 94, indicating marginal habitat conditions. Reduced score was primarily due to the decreased bank stability and reduced riparian zone, as a result of existing agricultural practices.

4. Spring 2012 Resident Fish Community Survey

4.1 Sampling Methods for the Fish Survey

A biologist team, consisting of qualified ARCADIS and AES personnel, conducted fish community surveys at 15 locations (Figure 4-1) in April 2012, following the methods outlined in the Study Plan (ARCADIS 2012c). Five water bodies were surveyed during the effort including: three locations in Little Lynches River, five locations each in HGMC and Camp Branch, and one location each in Buffalo Creek and an Unnamed Tributary to the southeast of HGMC. Specific survey coordinates of the fish study reaches are provided in Table 4-1.

To overlap the previous survey reaches, some locations were surveyed despite stream conditions not meeting SCDNR' Stream Assessment Protocol. For example, the siting of a reach should not be surveyed if it is naturally impounded (e.g., beaver activity), contains extensive channel braiding, if the channel is altered by a road crossing, or if it contains a tributary confluence. These locations were surveyed for fish species, however, specifically to update and verify locations where Sandhills chub had been previously observed.

Fish survey methods followed SCSA protocols, with sampling conducted on established stream reaches 20 to 30 times the average stream width (minimum length of 328 ft), using primarily backpack electrofishing techniques, supplemented with block nets and seines as appropriate. Based on the average stream widths, surveys were conducted with one to three backpack units. Specific protocols used at each location (i.e., number of backpack units, length of the survey reach) are provided in the field notes in Appendix C.

During the April 2012 field surveys, one deviation from the Study Plan was made during the survey, which was that location LLR6 was not surveyed during this effort for resident fish community. Timing constraints due to multiple aquatic surveys in the area (migratory fish survey, macroinvertebrate survey, habitat survey, and community fish survey) was the primary reason for the deviation, however the findings from the migratory fish survey in this vicinity, coupled with findings from the fall 2011 survey have adequately characterized the fish community in this area. Further, observations of habitat conditions in this reach made in 2011 indicated that stream conditions in this reach are directly and negatively impacted by livestock operations. Thus present aquatic conditions, and any future changes in conditions, in this area will reflect management practices of the livestock operations rather than conditions related to the

Site. The findings from the fall 2011 survey indicated that the Little Lynches River habitat within the vicinity and downstream of the Site is very consistently characterized as having in-stream habitat consisting of poorly defined pools, shallow runs and riffles. The fish community throughout the stretch of river surveyed showed consistent fish species assemblages and trophic level composition, with the majority of fish species consisting of insectivores (~90%), primarily from the shiner and chub families, with some sunfish and catfish species. Few predators were observed and four SC priority fish species were documented (flat bullhead, greenfin shiner, greenhead shiner, Piedmont darter).

Findings of the migratory fish survey at two locations straddling LLR6 (upstream MFS2 and downstream MFS3), showed a consistent trophic level composition of fish species collected during the electrofishing passes, and observed during fyke net, and eel trap efforts, as was surveyed in 2011. As described in Section 2.4, thirteen fish species were observed during the survey, with the majority of species (80%) consisting of insectivores (primarily shiner, chub and sunfish species). Few predator species and two SC priority fish species (flat bullhead and greenfin shiner) were observed.

4.2 Data Analysis Methods for the Fish Survey

All fish captured during the pass were enumerated and identified to species level, and recorded on fish data forms along with any noted anomalies. Taxonomic identification was performed using key diagnostics found primarily in *Freshwater Fishes of South Carolina* (Rohde et al. 2009). Personnel from ARCADIS and AES independently keyed out individuals periodically during the survey to provide an additional level of quality assurance/quality control.

Based on SCSA protocols, young-of-year (YOY) fish were identified to lowest practical level and enumerated separately. These were noted predominately at LLR5 station (Table 4-2). Photographs were taken of each species observed during the study. Additionally, water quality parameters measuring temperature, pH, conductivity, turbidity, dissolved oxygen (DO), and total dissolved solids (TDS) were recorded at each survey reach, prior to sampling.

The trophic group classifications are based on those found in Table 4 of North Carolina Department of Environment and Natural Resources' (NCDENR) *Standard Operating Procedure Biological Monitoring – Stream Fish Community Assessment Program* (NCDENR 2006). Relative abundance is a measure of the number of a particular

species as a percentage of the total number of individuals observed. Inverse index of diversity (1/D) is based on Simpson's formula for diversity:

$$D = \sum_{i=1}^s \left[\frac{n_i(n_i - 1)}{N(N - 1)} \right] \quad (1)$$

Where:

n_i = number of individuals per species

N = number of total individuals

The inverse index of diversity can range from 1 to the number of species observed. The higher the index value, then the higher the diversity.

4.3 Results of the Fish Survey

The following describes the results of the fish community survey work, and includes a summary of applicable community metrics, occurrence of SCDNR priority fish species, comparisons to previous survey results, and relative distribution of SCDNR priority fish species. Tables 4-1 through 4-7 provide summaries of species observed, composition of major trophic groups, relative abundance, inverse index of diversity, SCDNR priority fish species, water chemistry, and stream characteristics. Field data sheets, notes and photo-documentation are provided in Appendix C. Results are presented by survey location.

4.3.1 HGMC1

Location HGMC1 consisted of slightly flowing (0.69 ft/s) shallow water habitat with an average stream width of 2.8 ft and survey reach length of 328 ft. This location was sampled using one pass with one backpack electrofishing unit. Upon completion of these activities, no fish were observed; however several crayfish were observed. These results were similar to the fall 2011 survey. Water quality parameters for this location indicated acidic pH conditions (4.1) and a low dissolved oxygen concentration (6.23 ppm).

Previous survey locations by Rohde in July 1993 (R93-2) and SCDNR in March 2011 (SC11-194) were conducted in a reach of HGMC located approximately 0.3 miles downstream of HGMC1. During the July 1993 survey, three species were observed in this section of HGMC, including two SCDNR priority species (Sandhills chub and mud

sunfish), along with pirate perch. During the March 2011 survey, the Sandhills chub was the only fish species observed.

4.3.2 HGMC2

The lower location (HGMC2) within HGMC was below the culvert crossing on Haile Gold Mine Road and had flowing water (1.9 ft/s), with primarily riffle and runs and few shallow pool habitats. The average stream width was 5.6 ft and survey reach length was 328 ft. This location was sampled using one pass with one backpack electrofishing unit. One fish species, a yellow bullhead, was observed during the survey. No SCDNR priority fish species were observed at this location.

Previous survey locations by Rohde in July 1993 (R93-8) and SCDNR in March 2011 (SC11-193) were conducted slightly upstream in the vicinity of HGMC2. Historic observations also indicate limited numbers of fish at this location. In July 1993, Rohde did not observe any fish through the survey efforts. In March 2011, the SCDNR performed a survey near this location and observed five fish species: creek chubsucker, green sunfish, bluegill, golden shiner, and flat bullhead. During this survey, additional sampling effort was made outside of the standard sample section to yield the three additional fish species: creek chubsucker, bluegill, and golden shiner. During the fall 2011 survey performed by ARCADIS, three species were observed, including creek chubsucker, green sunfish, and bluegill.

4.3.3 HGMC3

This location overlaps the previous survey efforts by Rohde in July 1993 (R93-2) and SCDNR in March 2011 (SC11-194). The reach consisted of a mostly wetted channel (mean wetted width of 4.5 ft) with primarily run and shallow pool habitats with sandy-silt substrate and flowing water with an average flow velocity of 0.72 ft/s and an average depth of 0.36 ft. This location was sampled using one pass with one backpack electrofishing unit. A total of 60 fish were collected, representing only one species the Sandhills chub. The inverse index of diversity was low at 1.0, with a corresponding low catch-per unit effort (CPUE) of 0.2 fish per foot. The Sandhills chub represented the one SCDNR priority fish species observed at this location.

Previous survey efforts by Rohde in July 1993 (R93-2) and SCDNR in March 2011 (SC11-194) were conducted in approximately the same area. During the July 1993 survey, three species were observed in this section of HGMC, including two SCDNR priority species (Sandhills chub and mud sunfish), along with pirate perch. During the

March 2011 survey, the Sandhills chub was the only fish species observed, which is consistent with the recent spring 2012 findings.

4.3.4 HGMC4

This location overlaps the previous survey efforts conducted by Rohde in July 2008 (R08-3). The reach consisted of an entirely wetted channel (mean wetted width of 6.1 ft) with primarily run habitats of uniform depth, with little exposed substrate, and consisting of sandy-silt substrate overlain on some gravel. Flowing water was observed with an average flow velocity of 1.2 ft/s and an average depth of 0.92 ft. This location was sampled using one pass with one backpack electrofishing unit. A total of 54 fish were collected, representing three species, including predominantly the Sandhills chub (over 90% relative abundance), and few mud sunfish and pirate perch. The inverse index of diversity was low at 1.1, with a corresponding low CPUE of 0.2 fish per foot. Both the Sandhills chub and mud sunfish are SCDNR priority fish species.

Previous survey efforts by Rohde in July 2008 (R08-3) were conducted in approximately the same area. During the July 2008 survey, only the Sandhills chub was observed in this section of HGMC. This is generally consistent with the recent spring 2012 findings, based on the dominance of the Sandhills chub observed at this location.

4.3.5 HGMC5

This location overlaps the previous survey efforts conducted by Rohde in July 1993 (R93-1). The reach consisted of an impounded reach situated between two beaver dams, with a small portion of flowing channel. The reach was shortened to 174 ft, based on the presence of the beaver dams. The channel had a mean wetted width was 15.4 ft, with primarily pool habitats of uniform depth, with little exposed substrate, and consisting of silt substrates with abundant organic material. Flowing water was observed with an average flow velocity was 0.85 ft/s and average depth was 1.8 ft. This location was sampled using one pass with two backpack electrofishing units. A total of 84 fish were collected, representing four species, including predominantly pirate perch (67% relative abundance), with Sandhills chub (26% relative abundance), and few mud sunfish and bluegill. The inverse index of diversity was low at 2.0, with a corresponding low CPUE of 0.5 fish per foot. Both the Sandhills chub and mud sunfish are SCDNR priority fish species.

Previous survey efforts by Rohde in July 1993 (R93-1) were conducted in approximately the same area. During the July 1993 survey, only the Sandhills chub and pirate perch were observed in this section of HGMC. This is generally consistent with the spring 2012 findings, despite the potential changes of habitat by beaver activity between the survey efforts.

4.3.6 CB2

The upper Camp Branch location (CB2) was in a confined channel portion of the stream, with steep cut banks, flow moderate (1.3 ft/s), and the majority of the reach was shallow runs, with few riffles and shallow pools. The average stream width was 6.0 ft and the survey reach length was 328 ft. This location was sampled using one pass with one backpack electrofishing unit. A total of 252 fish collected, representing 9 species, and CPUE of 0.8 fish per foot was achieved. Nine fish species were observed during this survey, which resulted in a moderate inverse index of diversity of 4.3. Bluehead chub and rosieside dace accounted for approximately 60% relative abundance of the species observed at CB2. One SCDNR priority fish species, greenhead shiner, was observed during the survey.

Previous surveys were conducted by Rohde in August 2010 at six locations in the upper portions of Camp Branch. The closest location (R10-6) was approximately 0.43 miles upstream from CB2, and eight fish species were found during that survey. Of these eight species, two were SCDNR priority fish species (greenhead shiner and Sandhills chub). During the ARCADIS 2012 survey, a similar fish community was observed, comprised of five of the same fish species surveyed in August 2010.

4.3.7 CB3

The lower Camp Branch location (CB3) was in a higher gradient section of the stream, with firmer substrates and flows that could support riffles and runs. The average stream width was 10.6 ft and the survey reach length was 328 ft. This location was sampled using one pass with two backpack electrofishing units. A total of 189 fish, representing 10 species, were collected at this location, and a CPUE of approximately 0.6 fish per foot was achieved. The inverse index of diversity was moderate with a value of 4.6. Bluehead chub and rosieside dace accounted for over 55% relative abundance of the species observed at CB3. One SCDNR priority fish species, greenhead shiner, was observed during the survey.

Previous surveys were performed just downstream of CB3 by both Rohde in July 1993 (R93-11) and SCDNR in March 2011 (SC11-195). The results of these surveys showed similar fish species observed ($n = 9$) and relative abundance of bluehead chub and rosieside dace was similar to the results found in ARCADIS 2012 survey.

4.3.8 CB4

This location overlaps the previous survey efforts conducted by Rohde in August 2010 (R10-4), within the upper section of Camp Branch. The channel is influenced by the presence of some beaver dams, which Rohde had noted in his survey report. The beaver dam presence influenced some channel braiding, and broadened the channel in some areas. The average wetted width was 11.1 ft and the survey reach length was 328 ft. The channel consisted equally of shallow pool and run habitats, with an average depth of 0.66 ft and an average flow velocity of 0.62 ft/s. This location was sampled using one pass with two backpack electrofishing units. A total of 84 fish, representing 5 species, were collected at this location, and a CPUE of approximately 0.3 fish per foot was achieved. The inverse index of diversity was moderate with a value of 4.2. Redbreast sunfish and green sunfish accounted for over 55% relative abundance of the species observed at CB4. No SCDNR priority fish species were observed during the survey.

Previous surveys efforts by Rohde in August 2010 (R10-4) were conducted in approximately the same area. The results of the August 2010 survey indicated the presence of Sandhills chub, creek chubsucker, and green sunfish. The results of the ARCADIS 2012 survey did not indicate the presence of Sandhills chub, but rather the creek chub was observed.

4.3.9 CB5

This location overlaps the previous survey efforts conducted by Rohde in August 2010 (R10-2), within the upper section of Camp Branch. Baseflow conditions are influenced by an upstream beaver dam. The channel consisted mainly of shallow runs, with poorly defined pools consisting of sands and silts and some exposed riffle habitat. The average wetted width was 5.7 ft and the survey reach length was 328 ft. The average depth was 0.39 ft and the average flow velocity was 0.67 ft/s. This location was sampled using one pass with one backpack electrofishing unit. A total of 21 fish, representing 5 species, were collected at this location, and an extremely low CPUE of approximately 0.1 fish per foot was achieved. The inverse index of diversity was low with a value of 2.5. Creek chub accounted for over 60% relative abundance of the

species observed at CB5. No SCDNR priority fish species were observed during the survey.

Previous surveys efforts by Rohde in August 2010 (R10-2) were conducted in approximately the same area. The results of the August 2010 survey indicated the presence of Sandhills chub, redbreast sunfish, and tessellated darter. The results of the ARCADIS 2012 survey did not indicate the presence of Sandhills chub, but rather the creek chub was observed as the dominant fish species. Both the redbreast sunfish and tessellated darter were observed during the 2012 survey.

4.3.10 CB6

This location overlaps the previous survey efforts conducted by Rohde in August 2010 (R10-6), within the upper section of Camp Branch. The channel consisted mainly of shallow runs, with poorly defined pools consisting of sands and silts and some exposed riffle habitat, and an abundant amount of LWD. The average wetted width was 8.9 ft and the survey reach length was 328 ft. The average depth was 0.47 ft and the average flow velocity was 1.4 ft/s. This location was sampled using one pass with two backpack electrofishing units. A total of 102 fish, representing 8 species, were collected at this location, and a low CPUE of approximately 0.3 fish per foot was achieved. The inverse index of diversity was low with a value of 2.9. Rosyside dace accounted for over 55% relative abundance of the species observed at CB6. No SCDNR priority fish species were observed during the survey.

Previous surveys efforts by Rohde in August 2010 (R10-6) were conducted in approximately the same area. The results of the August 2010 survey indicated eight species including Sandhills chub, creek chub, rosyside dace, bluehead chub, highfin shiner, greenhead shiner, bluegill, and tessellated darter. The results of the ARCADIS 2012 survey did not indicate the presence of Sandhills chub, but did still indicate the presence of creek chub.

4.3.11 LLR1

LLR1 is located on the Little Lynches River, upstream of the Camp Branch confluence, in a section of river with primarily low gradient runs and few shallow pool and riffle habitats, comprised mainly of sandy and gravel substrate. The average stream width was 19 ft and the survey reach length was 564 ft. This location was sampled using one pass with two backpack electrofishing units. A total of 296 fish, representing 14 species, were collected and a CPUE of approximately 0.5 fish per foot was achieved.

The inverse index of diversity was moderate with a value of 6.4. Highfin shiner and greenfin shiner accounted for over 40% relative abundance of the species observed at LLR1. Two SCDNR priority fish species, greenfin shiner and flat bullhead, were observed during the survey.

In March 2011, SCDNR performed a fish community survey approximately 1.1 miles upstream of LLR1 (at location SC11-86893). A total of 14 fish species were observed at this location during the SCDNR survey, whereas 11 fish species were observed during the ARCADIS 2011 survey. Similar fish communities were observed, as highfin shiner and tessellated darter were two of the primary abundant fish species observed.

4.3.12 LLR2

LLR2 is approximately 0.25 miles downstream of the Camp Branch confluence, in a section of the Little Lynches River with primarily low gradient runs and few shallow pool and riffle habitats, comprised mainly of sandy substrate. The average stream width was 24 ft and the survey reach length was 715 ft. This location was sampled using one pass with three backpack electrofishing units. A total of 1,033 fish, representing 11 species, were collected and a CPUE of approximately 1.4 fish per foot was achieved. The inverse index of diversity was low at a value of 1.5, based on the high relative abundance of one species. Highfin shiner accounted for approximately 80% relative abundance of the species observed at LLR2. No SCDNR priority fish species were observed during the survey. No previous fish surveys have been performed in the vicinity of location LLR2 to our knowledge.

4.3.13 LLR4

LLR4 is approximately 0.2 miles downstream of the HGMC confluence, in a section of the Little Lynches River with primarily low gradient runs and few shallow riffles and deeper pool habitats, comprised mainly of sandy substrate. The average stream width was 25.6 ft and the survey reach length was 768 ft. This location was sampled using one pass with three backpack electrofishing units. A total of 232 fish, representing 21 species, were collected and a CPUE of approximately 0.3 fish per foot was achieved. The inverse index of diversity was high with a value of 7.5, based on the species richness and more equivalent relative abundance of species observed. Highfin shiner and redbreast sunfish accounted for over 40% relative abundance of the species observed at LLR4. Four SCDNR priority fish species, flat bullhead, greenfin shiner, greenhead shiner, and Piedmont darter were observed during the survey.

Historic fish surveys were performed by Rohde at the confluence of HGMC in July 1993 (R93-10) and July 2008 (R08-9). During these surveys, 19 fish species were observed, including four SCDNR priority species: greenfin shiner, greenhead shiner, flat bullhead, and Piedmont darter. Highfin shiner and tessellated darter comprised nearly 40% relative abundance of the species observed. The results of the spring 2012 survey are similar to these past findings.

4.3.14 BC2

BC2 is in the upper section of Buffalo Creek approximately 328 ft upstream of the bridge crossing on Payne Road. The section of creek surveyed was narrow with mixed substrates, undercut banks, and woody debris. Stream morphology in this section of creek consisted of runs, with numerous riffles, and several shallow pool habitats. The average stream width was 10.2 ft and the survey reach length was 328 ft. This location was sampled using one pass with two backpack electrofishing units. A total of 28 fish, representing 5 species, were collected and a CPUE of approximately 0.09 fish per foot was achieved. The inverse index of diversity was low to moderate at a value of 3.2. Sandhills chub and pirate perch accounted for approximately 75% relative abundance of the species observed at BC2. One SCDNR priority fish species, Sandhills chub, was observed during the survey. No previous fish surveys have been performed in the near vicinity of this location to our knowledge.

4.3.15 Unnamed Tributary

The fish community survey included one location in the Unnamed Tributary (UT1; Figure 4-1). UT1 is in the middle section of the Unnamed Tributary, and was narrow with mixed substrates, some undercut banks, and woody debris. Stream morphology in this section of creek consisted primarily of runs, with fewer riffles, and limited pool habitats. The average stream width was 4.6 ft and the survey reach length was 328 ft. This location was sampled using one pass with one backpack electrofishing unit. A total of 47 fish, representing 2 species (Sandhills chub and pirate perch) were collected and a CPUE of approximately 0.1 fish per foot was achieved. The inverse index of diversity was very low at a value of 1.2, based on the high relative abundance of the Sandhills chub. Sandhills chub accounted for nearly 90% relative abundance of the species observed at UT1. One SCDNR priority fish species, Sandhills chub, was observed during the survey. No previous fish surveys have been performed in the Unnamed Tributary to our knowledge.

4.4 Summary of Results

The five water bodies surveyed in 2012 by ARCADIS and AES confirmed the distribution and occurrence of most fish species that had been previously observed. The water bodies surveyed are shown to support primarily insectivore fish species, representing mainly cyprinids (minnows) and centrarchids (sunfish). Few omnivore and predator species were observed in these water bodies. Fish abundance was moderate to high at most locations, except for HGMC survey reaches HGMC1 and HGMC2. Relative abundance of fish species across all locations was comprised primarily of highfin shiner, redbreast sunfish, rosyside dace, bluehead chub. Sandhills chub was abundant in HGMC and the Unnamed Tributary. The inverse index of diversity indicated low to moderate fish diversity within most locations, with the highest diversity and richness observed at downstream reaches of Little Lynches River (LLR4) and the lowest diversity observed in HGMC (HGMC1). This relative difference is as to be expected given the relatively greater habitat diversity and availability in the Little Lynches.

SCDNR priority fish species were found in all water bodies. Historic observations of fish, including the Sandhills chub, in HGMC upstream of Ledbetter Reservoir have been made previously by Rohde (1993, 2008) and SCDNR (2011). The surveys conducted at three of Rohde's previous survey locations (HGMC3, HGMC4, and HGMC5) confirmed the presence of the Sandhills chub. The most upstream location in HGMC (HGMC1) still did not show signs of resident fish during this spring survey effort. In the upper reach of Camp Branch, (CB4, CB5, and CB6), only Creek chub were observed, whereas both Sandhills and creek chub were observed previously by Rohde (2010). ARCADIS and AES biologists independently keyed out specific taxonomic characteristics of specimens surveyed, and examined numerous individuals within each of the reaches, to confirm the appropriate taxonomic identifications.

4.5 Changes in the Observed Distribution of Sandhills Chub

The Sandhills chub occurs in the headwaters of coastal plain streams in the Sandhills region of south-central North Carolina and north-central South Carolina (NatureServe 2012). In South Carolina, it is almost wholly restricted to the Sandhills ecoregion in headwater streams. Streams or rivers with headwaters in the Sandhills ecoregion are considered blackwater streams. Water quality conditions were consistent with this types of system, and included a naturally low pH, tannic (blackwater) stained color, and low to moderate dissolved oxygen conditions. Water temperatures ranged from

approximately 54 to 73 degrees Fahrenheit, as flow conditions were generally slightly higher than those observed during the fall 2011 survey effort.

Based on the habitat information available for the Sandhills chub (Snelson and Snuttkus 1978, Rohde and Arndt 1991), along with local survey information provided in Rohde (2008), this species is typically found in headwater creeks with sandy and/or gravel substrates and sparse aquatic vegetation. The observed habitats in the upper reaches of Camp Branch and HGMC are generally supportive of these conditions.

Changes in habitat and other natural variables may possibly explain the differences observed between the previous and current survey efforts conducted in Camp Branch with particular regard to the presence and/or absence of the Sandhills chub. These may include the presence of beaver activity, extended periods of drought, influence of LWD, and road crossings. Figure 4-2 provides a summary of observed in-stream natural and man-made barriers that currently exist within the site boundary segments of Camp Branch, HGMC, and Little Lynchies River. Several photograph examples of in-stream natural and man-made barriers within the upper HGMC are provided in Appendix B as photographs #13 through 16.

Extensive beaver activity (mostly dormant dams) was observed in the upper reaches of Camp Branch (primarily near CB4), which was also noted by Rhode during surveys in 2010. The existing beaver dams alter the natural channel geomorphology of the streams observed in this section of Camp Branch. Channel substrates and flows are thus altered over time, which may be a factor in the presence and/or absence of the Sandhills chub.

Additionally, periods of drought during the last several years may influence the ability of fish species to exist in certain reaches of the creek, due to exposed shallow riffle habitats which may create a non-contiguous wetted channel. Low discharge conditions during drought can limit habitat resources and fish mobility (Lohr and Fausch 1997). Reproduction and juvenile recruitment can also be negatively affected by environmental stress associated with drought conditions (Freeman et al. 1988; Schlosser et al. 2000). Drought can also simply kill fish directly, causing potential extirpation from an area (Lohr and Fausch 1997). Based on South Carolina State Climatology Office (SCDNR 2012) records for Lancaster County, moderate to extensive drought conditions had existed continuously from June 6, 2007 to February 19, 2009. This was followed by a slight recovery toward normal conditions, with incipient drought conditions returning from July 9, 2010 through June 17, 2011.

Moderate drought conditions have existed from July 14, 2011 through March 9, 2012; with current conditions recently noted on April 25, 2012 as moderate.

The role of LWD on the ecological processes is critically important in regulating sediment transport and diversifying channel form, thereby also having major effects on aquatic and riparian ecology (e.g., Bisson et al. 1981; Sullivan 1986; Bilby and Bisson 1998). Within similar blackwater systems, LWD greatly influences the geomorphology of the lower order and headwater creeks. Debris dams, typically composed of one or more pieces of LWD and many smaller pieces, slow the flow of water, trap sediment and organic matter and create microhabitats for fish and benthic macroinvertebrates (Dolloff 1995). Observations of substantial LWD were noted at CB6 and HGMC1, and in some cases showed the ability to create in-stream barriers. During low-flow periods, these may act as natural barriers to prevent fish movement.

Culvert at upstream section of the HGMC3 (previous R93-2 and SC11-194) may provide a natural barrier, during times of low flow, which prevents potential migration of fish upstream to HGMC1. Road crossings and improperly sized culverts can directly affect fish movement by either acting as a physical barrier or by altering flows, and contributing to sedimentation (Harper and Quigley 2000), thereby limiting a fish's ability to successfully traverse a crossing (Warren and Pardew 1998, Bouska and Paukert 2009). If the culvert effectively prevents fish from moving between upstream and downstream habitats, then habitat fragmentation and subsequent isolation of populations may occur. Road crossings may also prevent or significantly reduce the ability of fish to move freely and reestablish a species' presence in a reach from which it has been extirpated.

4.6 Results of Spring Herptile Survey

Herptile surveys were conducted by ARCADIS personnel from April 4 to April 8, 2012. These surveys were conducted concurrently with the fish surveys in five stream systems: Buffalo Creek, Camp Branch, HGMC, Little Lynches River and Unnamed Tributary (Figure 4-1). The surveys followed methods described in the Study Plan (ARCADIS 2012c).

The herptile species that were observed during the surveys are shown in Table 4-8. Herptiles were observed at most survey locations. Five species of frog, three species of salamander, two species of turtle, one species of lizard and one species of snake were observed during the surveys. The green frog (*Rana clamitans clamitans*), the southern two-lined salamander (*Eurycea cirrigera*) and the green anole (*Anolis*

carolinensis) were the most commonly seen species. The number of species observed was highest along HGMC. Field notes and photo documentation of each survey site are provided in Appendix C.

5. Spring 2012 Macroinvertebrate Survey

5.1 Sampling Methods for the Macroinvertebrate Survey

Benthic macroinvertebrate population surveys were conducted following methods described in the Study Plan (ARCADIS 2012c). ETT personnel conducted the survey from April 24 to April 26, 2012. Data analysis and data interpretation was completed by ARCADIS. Sampling methods followed the same methods used for the annual National Pollutant Discharge Elimination System (NPDES)–required macroinvertebrate survey program in HGMC (ETT 2010). These methods are consistent with SCDHEC's macroinvertebrate sampling SOP (SCDHEC 1998). No deviations due to weather were made during this survey.

At each survey site, macroinvertebrates were collected from erosional (riffle) and depositional stream habitats using sampling equipment appropriate for the habitat. Collection from riffle habitats included the use of an aquatic dip net (0.024 inches) mesh, a #30 mesh sieve, and hand collection of snag habitats. Aquatic dip nets were also used to sample depositional areas of streams that included submerged leaf packs, undercut banks and root mats.

5.2 Data Analysis for the Macroinvertebrate Survey

Three types of metrics were calculated from the data collected:

1. RBP metrics
2. Bioclassification Score
3. Aquatic Life Use Support (ALUS)

5.2.1 RBP Metrics

RBP metrics were calculated at each site to assess community structure and provide interpretation as to level of impairment observed at each site. The eight metrics that were calculated followed the guidelines for benthic community evaluation metrics provided in the USEPA RBP protocols (Barbour et al., 1999). Each metric is defined below:

Taxa richness – Total number of species collected at a site and indicative of diversity. Reduced diversity has been positively associated with various forms of environmental

pollution, including nutrient loading, toxic substances, and sedimentation (Barbour et al., 1996).

EPT index – total number of species from the Ephemeroptera, Plecoptera, and Trichoptera orders of insects. Species in these orders are typically sensitive to pollution and are therefore good indicators of water quality in fast moving streams (Barbour et al. 1996, Lenat 1988).

EPT to Chironomid ratio – ratio of sensitivity of EPT insects to species (i.e., Chironomids) more tolerant of reduced water quality. The relative abundance of these four indicator groups is a measure of community balance. When compared to a reference site, good biotic conditions are reflected in a fairly even distribution among these four groups (Plafkin et al. 1989). A high ratio indicates a greater proportion of the macroinvertebrate community is composed of sensitive species.

Percent dominant taxon – percent of the most abundant species identified at each site. This measures the redundancy and evenness of the community structure. It assumes a highly redundant community reflects an impaired community because as the more sensitive taxa are eliminated, there is often a significant increase in the remaining tolerant forms (Barbour et al. 1996).

Community loss index – similarity between upstream control locations and downstream locations that have been impacted in some way. It is an index of dissimilarity, with value increasing as the degree of dissimilarity from the reference condition increases (Plafkin et al. 1989).

Ratio of scrapers to collector-filterers – the ratio of two trophic categories of invertebrates. A low ratio is often indicative of streams undergoing nutrient loading and eutrophication. As nutrient loading to a stream increases, so does fine particulate organic matter, such as diatoms, which in turn supports a higher proportion of filter feeding benthic organisms.

Ratio of Shredders to Total Number of Organisms – a ratio of shredders to the total number of organisms. A low ratio is often indicative of the presence of pollutants associated with coarse organic matter. Shredders that consume coarse organic matter are frequently disproportionately affected by such forms of pollution.

Biotic index (BI) – a weighted average of tolerance values (indicating tolerance to environmental pollution) for the species collected at the site. This index is similar to the

Hilsenhoff Biotic Index, with tolerance values derived from the NC database based on a 0 – 10 scale, where 0 represents the best water quality and 10 represents the worst (NCDENR 2011). The NCDENR protocols have established criteria for three ecological regions: mountain, Piedmont, and coastal plain. The classification of BI is sensitive to the time of collection with respect to available community organisms and thus correction factors were established (NCDENR 2011).

A classification rating is scaled based on the BI score and may represent five categories, ranging from “Poor”, “Fair”, “Good–Fair”, “Good”, and “Excellent” (NCDENR 2011). Low values for the BI are indicative of habitat that has high numbers of sensitive species. BI may not measure impacts that are largely due to habitat (e.g., sediment), especially if measurements are conducted after a period of scour when sediment–tolerant species (i.e., stable–sand community) have not re–established, or chironomids are sparse (NCDENR 2011). For sites where such habitat changes are the primary cause of stress BI should be used with caution and discussion of results should clearly note the influence of sediment and flow (NCDENR 2011).

5.2.2 Bioclassification

Bioclassification scores were determined for each site in the Sandhills Region. SCDHEC protocols (SCDHEC 1998) were followed to assign a bioclassification score, which uses the EPT Index and the BI to categorize impairment levels and aquatic life usage within the Sandhills region. The SCDHEC protocols are used to make stream impairment judgments for South Carolina’s Watershed Water Quality Management Strategy program and for point/nonpoint source impact assessments (SCDHEC 1998). The bioclassification scoring system is detailed in Table 4-17. Bioclassification of streams in South Carolina is based on the combination of equally weighted BI and EPT scores, and parallels North Carolina’s criteria range, where:

- Excellent = 5
- Good = 4
- Good–Fair = 3
- Fair = 2
- Poor = 1

Borderline classifications are assigned near half–step values (1.4, 2.6, etc.) and are defined as boundary EPT and BI values (SCDHEC 1998). The two ratings are averaged together to produce a combined score which determines the final

bioclassification. When the combined score falls between two bioclassifications, it is either rounded up or down based on whether the decimal fraction is larger or smaller than 0.5 (SCDHEC 1998). In cases where the decimal fraction is exactly 0.5, other metrics are considered to determine which bioclassification to assign. Metrics considered are: taxa richness, EPT abundance, feeding groups (i.e. filter feeders, predators, etc.) and habitat information (SCDHEC 1998).

5.2.3 Aquatic Life Use Support

The bioclassification scores are used to assign an aquatic life use support (ALUS), based on the provisions outlined in the Clean Water Act (Section 305b). The criteria used to measure ALUS are summarized in three categories: Fully Supporting, Partially Supporting and Not Supporting. Definitions of these terms are as follows:

Fully Supporting: Data indicate the presence of functioning, sustainable biological assemblages (e.g. fish, macroinvertebrates, or algae which have not been modified significantly beyond the natural range of the reference condition).

Partially Supporting: At least one assemblage indicates moderate modification of the biological community as compared to the reference condition.

Not Supporting: At least one assemblage indicates a severely impacted macroinvertebrate community. Data clearly indicate severe modification of the biological community compared to the reference condition).

The SCDHEC's Aquatic Biology Section determines the ALUS based on the bioclassification of the stream, where:

<u>Bioclassification Rank</u>	<u>ALUS Rank</u>
Excellent and Good	Fully Supporting
Good–Fair and Fair	Partially Supporting
Poor	Not Supporting

5.3 April 2012 Benthic Macroinvertebrate Survey Results

Below are the April 2012 survey results by stream reach for each of the 17 sample locations (Figure 5-1), based on the field surveys and taxonomic evaluation conducted

by ETT. Tables 5-1 and 5-2 show the benthic macroinvertebrate species collected and the community assessment metrics calculated for each survey site.

Biological index scores obtained during this sampling event were generally good (minimum 3.01, maximum 7.20, average 5.54), and typical of only slightly impaired or unimpaired conditions. EPT index scores did not fare as well, with generally low scores indicating some degree of impairment (minimum 0.0, maximum 15.0, average 8.0). Overall, the April 2012 survey showed variable habitat conditions that either fully or partially support aquatic life uses. The resulting bioclassification scores ranged from fair to good. Results from each sampling location are presented below.

5.3.1 Buffalo Creek (Site BC2)

Taxa richness was high, with 300 organisms surveyed, comprising 43 taxa. The number of EPT species was highest among the April 2012 sampling locations at 15 taxa. The dominant taxa surveyed were *Perlesta sp.* stoneflies and *Conchapelopia sp.* dipterans. Biotic index (4.49) and EPT index (15.0) values combined to yield a “good” bioclassification score, which is indicative of an environment that fully supports aquatic life use.

5.3.2 Unnamed Tributary (Site UT1)

Taxa richness was moderate, with 173 organisms surveyed, comprising 24 taxa. The number of EPT species was moderate, as 10 taxa were observed. The dominant taxa surveyed were *Leuctra sp.* stoneflies and *Conchapelopia sp.* dipterans. Biotic index (3.01) and EPT index (10.0) values combined to yield a “good” bioclassification score, which is indicative of an environment that fully supports aquatic life use.

5.3.3 Camp Branch (Site CB2)

Taxa richness was moderate, with 189 organisms surveyed, comprising 28 taxa. The number of EPT species was moderate, as 11 taxa were observed. The dominant taxa surveyed were *Isonychia sp.* mayflies and *Perlesta sp.* stoneflies. Biotic index (4.91) and EPT index (11.0) values combined to yield a “good-fair” bioclassification score, which is indicative of an environment that is partially supportive of aquatic life use.

5.3.4 Camp Branch (Site CB3)

Taxa richness was high, with 160 organisms surveyed, comprising 46 taxa. The number of EPT species was moderate, as 12 taxa were observed. The dominant taxa surveyed were *Maccaffertium* sp. mayflies and *Cheumatopsyche* sp. caddisflies. Biotic index (5.84) and EPT index (12.0) values combined to yield a “good-fair” bioclassification score, which is indicative of an environment that is partially supportive of aquatic life use.

5.3.5 Camp Branch (Site CB4)

Taxa richness was moderate, with 72 organisms surveyed, comprising 24 taxa. No EPT species were observed. The dominant taxa surveyed were *Neoporus* sp. beetles and *Notonecta* sp. hemipterans. Biotic index (6.77) and EPT index (0.0) values combined to yield a “fair” bioclassification score, which is indicative of an environment that is partially supportive of aquatic life use.

5.3.6 Camp Branch (Site CB5)

Taxa richness was moderate, with 169 organisms surveyed, comprising 34 taxa. The number of EPT species was low, as only 5 species were observed. The dominant taxa observed were *Perlesta* sp. stoneflies and *Conchapelopia* sp. dipterans. Biotic index (5.31) and EPT index (5.0) values combined to yield a “good-fair” bioclassification score, which is indicative of an environment that is partially supportive of aquatic life use.

5.3.7 Camp Branch (Site CB6)

Taxa richness was moderate, with 166 organisms surveyed, comprising 31 taxa. The number of EPT species was low, as only 8 species were observed. The dominant taxa observed were *Perlesta* sp. stoneflies and *Conchapelopia* sp. dipterans. Biotic index (4.51) and EPT index (8.0) values combined to yield a “good” bioclassification score, which is indicative of an environment that is fully supportive of aquatic life use.

5.3.8 Haile Gold Mine Creek (Site HGMC1)

Taxa richness was low, with 38 organisms surveyed, comprising 15 taxa. The number of EPT species was low, as only 2 species were observed. The dominant taxa observed were *Caecidotea* sp. crustaceans. Biotic index (6.77) and EPT index (2.0)

values combined to yield a “fair” bioclassification score, which is indicative of an environment that is partially supportive of aquatic life use.

5.3.9 Haile Gold Mine Creek (Site HGMC2)

Taxa richness was low, with 63 organisms surveyed, comprising 14 taxa. The number of EPT species was low, only 1 species was observed. The dominant taxa observed were *Conchapelopia* and *Polypedilum sp.* dipterans. Biotic index (7.20) and EPT index (1.0) values combined to yield a “fair” bioclassification score, which is indicative of an environment that is partially supportive of aquatic life use.

5.3.10 Haile Gold Mine Creek (Site HGMC3)

Taxa richness was moderate, with 183 organisms surveyed, comprising 23 taxa. The number of EPT species was low, as only 7 species were observed. The dominant taxa observed were *Leuctra* and *Perlesta sp.* stoneflies. Biotic index (4.86) and EPT index (7.0) values combined to yield a “good-fair” bioclassification score, which is indicative of an environment that is partially supportive of aquatic life use.

5.3.11 Haile Gold Mine Creek (Site HGMC4)

Taxa richness was moderate, with 174 organisms surveyed, comprising 36 taxa. The number of EPT species was moderate, as 12 species were observed. The dominant taxa observed were *Maccaffertium* and *Leuctra sp.* stoneflies, and *Conchapelopia sp.* dipterans. Biotic index (5.30) and EPT index (12.0) values combined to yield a “good-fair” bioclassification score, which is indicative of an environment that is partially supportive of aquatic life use.

5.3.12 Haile Gold Mine Creek (Site HGMC5)

Taxa richness was moderate, with 787 organisms surveyed, comprising 23 species. Despite the high numbers of organisms observed, many highly tolerant species were found and the number of EPT species was low, as only 7 species were observed. The dominant taxa observed were *Conchapelopia* and *Psectrocladius sp.* dipterans. Biotic index (5.91) and EPT index (7.0) values combined to yield a “good-fair” bioclassification score, which is indicative of an environment that is partially supportive of aquatic life use.

5.3.13 Little Lynches River (Site LLR1)

Taxa richness was high, with 580 organisms surveyed, comprising 44 species. The number of EPT species was moderate, with 12 species observed. The dominant taxa observed were *Polypedilum* and *Simulium* sp. dipterans. Biotic index (5.68) and EPT index (12.0) values combined to yield a “good-fair” bioclassification score, which is indicative of an environment that is partially supportive of aquatic life use.

5.3.14 Little Lynches River (Site LLR2)

Taxa richness was high, with 264 organisms surveyed, comprising 37 species. The number of EPT species was low, as only 4 species were observed. The dominant taxa observed were *Chironomus* and *Ablabesmyia* sp. dipterans. Biotic index (7.14) and EPT index (4.0) values combined to yield a “fair” bioclassification score, which is indicative of an environment that is partially supportive of aquatic life use.

5.3.15 Little Lynches River (Site LLR3)

Taxa richness was high, with 259 organisms surveyed, comprising 50 species. The number of EPT species was moderate, with 13 species observed. The dominant taxa observed were *Perlesta* sp. stoneflies and *Polypedilum* sp. dipterans. Biotic index (5.70) and EPT index (13.0) values combined to yield a “good-fair” bioclassification score, which is indicative of an environment that is partially supportive of aquatic life use.

5.3.16 Little Lynches River (Site LLR4)

Taxa richness was high, with 180 organisms surveyed, comprising 39 species. The number of EPT species was moderate, with 11 species observed. The dominant taxa observed were *Isonychia* sp. mayflies and *Perlesta* sp. stoneflies. Biotic index (5.48) and EPT index (11.0) values combined to yield a “good-fair” bioclassification score, which is indicative of an environment that is partially supportive of aquatic life use.

5.3.17 Little Lynches River (Site LLR6)

Taxa richness was high, with 278 organisms surveyed, comprising 37 species. The number of EPT species was moderate, with 11 species observed. The dominant taxa observed were *Isonychia* sp. mayflies and *Perlesta* sp. stoneflies. Biotic index (5.26)

and EPT index (11.0) values combined to yield a “good-fair” bioclassification score, which is indicative of an environment that is partially supportive of aquatic life use.

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Haile Gold Mine

Spring 2012 Aquatic
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Tables

Table 2-1
Summary of ARCADIS Spring 2012 Migratory Fish Survey Locations

Haile Gold Mine, Inc.
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Survey Location	Waterbody	Survey Reach Coordinates ¹				Reach Length (ft)
		Upstream Point		Downstream Point		
		Latitude	Longitude	Latitude	Longitude	
MFS1	LLR	34.57740	-80.56732	34.57654	-80.56596	504
MFS2	LLR	34.52938	-80.53509	34.52788	-80.53475	561
MFS3	LLR	34.47955	-80.50571	34.47942	-80.50516	467
MFS4	HGMC	34.56330	-80.55094	34.56274	-80.55145	290
MFS5	CHB	34.57658	-80.56486	34.57586	-80.56448	294
MFS6	CB	34.58769	-80.56937	34.58670	-80.56936	393

Abbreviations:

CB = Camp Branch

CHB = Champion Branch

ft = feet

HGMC = Haile Gold Mine Creek

LLR = Little Lynches River

MFS = Migratory Fish Survey

Notes:

¹ Sample coordinates are in decimal degrees, based on WGS 84 reference datum.

Table 2-2
Stream Flow and Water Quality Parameters Measured During ARCADIS Spring 2012 Migratory Fish Survey

Haile Gold Mine, Inc.
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Location (Water Body)	Stream Flow ¹ (ft/s)	Water Quality Parameters ²					
		Temperature (°F)	pH	Specific Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (ppm)	Total Dissolved Solids
First Sampling Event (March 27 th - 31 st , 2012)							
MFS1 (LLR)	0.23	60.12	7.92	0.073	9.8	8.93	--
MFS2 (LLR)	1.1	65.21	7.53	0.070	16.5	10.42	--
MFS3 (LLR)	1.0	63.91	6.77	0.065	6.8	8.36	--
MFS4 (HGMC)	0.95	57.11	4.26	0.107	35.2	10.35	--
MFS5 (CHB)	0.16	55.83	6.24	0.032	5.5	9.92	--
MFS6 (CB)	0.16	66.96	6.42	0.033	46.5	9.30	--
Second Sampling Event (April 16 th - 19 th , 2012)							
MFS1 (LLR)	0.59	66.51	7.16	0.083	3.8	9.65	0.0061
MFS2 (LLR)	1.1	64.69	7.02	0.064	7.4	10.56	0.0052
MFS3 (LLR)	0.85	64.04	6.87	0.056	15.7	8.73	0.0042
MFS4 (HGMC)	0.89	70.09	4.00	0.161	3.5	9.88	0.0113
MFS5 (CHB)	0.39	69.96	6.83	0.039	10.0	10.12	0.0028
MFS6 (CB)	0.92	66.87	7.13	0.039	14.0	9.93	0.0028

Abbreviations:

-- = total dissolved solids not measured during the first sampling event due to equipment failure.

% = percentage

°F = degrees Fahrenheit

CB = Camp Branch

CHB = Champion Branch

HGMC = Haile Gold Mine Creek

LLR = Little Lynches River

mS/cm = milliSiemens per centimeter

NTU = nephelometric turbidity units

ppm = parts per million

Notes:

¹ Stream flow measured in the field using a Marsh-McBirney™ flow meter.

² Water quality parameters measured in the field using a YSI 650 MDS™ multi-parameter probe meter.

Table 2-3
Results of Fish and Reptile Species Collected During ARCADIS Spring 2012 Migratory Fish Survey¹

Haile Gold Mine, Inc.
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Scientific Name	Common Name	Location								
		MFS1								
		Day 1			Day 2			Day 3		
		Electro-fishing	Fyke Net	Eel Trap	Electro-fishing	Fyke Net	Eel Trap	Electro-fishing	Fyke Net	Eel Trap
First Sampling Event (March 27th - 31st, 2012)										
Migratory Species										
<i>Anguilla rostrata</i>	American Eel	1	--	--	--	--	--	--	--	--
Resident Species										
<i>Ameiurus platycephalus</i>	Flat bullhead*	--	--	--	--	--	--	--	--	1
<i>Aphredoderus sayanus</i>	Pirate perch	--	--	1	--	--	2	--	--	5
<i>Cyprinella chloristia</i>	Greenfin shiner*	--	--	6	--	--	--	--	--	--
<i>Erimyzon oblongus</i>	Creek chubsucker	--	--	--	--	1	--	--	1	--
<i>Etheostoma olmstedii</i>	Tessellated darter	--	--	--	--	--	--	--	--	2
<i>Lepomis auritus</i>	Redbreast sunfish	--	--	6	--	--	4	--	--	17
<i>Minytrema melanops</i>	Spotted sucker	--	--	--	--	--	--	--	--	--
<i>Moxostoma cupiscartes</i> or	Brassy jumprock	--	--	--	--	1	--	--	--	--
<i>Scartomyzon sp.</i> ²										
<i>Nocomis leptcephalus</i>	Bluehead chub	--	--	2	--	--	1	--	--	1
<i>Notropis cummingsae</i>	Dusky shiner	--	--	1	--	--	--	--	--	--
<i>Notropis procne</i>	Swallowtail shiner	--	--	--	--	--	--	--	--	1
<i>Noturus insignis</i>	Margined madtom	--	--	--	--	--	--	--	--	1
Reptiles										
<i>Chelydra serpentina</i>	Snapping turtle	--	--	--	--	--	--	--	--	--
<i>Trachemys scripta scripta</i>	Yellowbelly Slider	--	1	--	--	--	--	--	--	--
Total Number of Fish:		1	0	16	0	2	7	0	1	28
Total Number of Fish Species:		1	0	5	0	2	3	0	1	7

Table 2-3
Results of Fish and Reptile Species Collected During ARCADIS Spring 2012 Migratory Fish Survey¹

Haile Gold Mine, Inc.
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Scientific Name	Common Name	Location								
		MFS2								
		Day 1			Day 2			Day 3		
		Electro-fishing	Fyke Net	Eel Trap	Electro-fishing	Fyke Net	Eel Trap	Electro-fishing	Fyke Net	Eel Trap
First Sampling Event (March 27th - 31st, 2012)										
Migratory Species										
Anguilla rostrata	American Eel	--	--	--	--	--	--	--	--	--
Resident Species										
Ameiurus platycephalus	Flat bullhead*	--	--	4	--	--	--	--	--	--
Aphredoderus sayanus	Pirate perch	--	--	2	--	--	7	--	--	--
Cyprinella chloristia	Greenfin shiner*	--	--	--	--	--	2	--	--	--
Erimyzon oblongus	Creek chubsucker	--	--	--	--	--	--	--	--	--
Etheostoma olmstedii	Tessellated darter	--	--	--	--	--	3	--	--	--
Lepomis auritus	Redbreast sunfish	--	--	2	--	--	3	--	--	3
Minytrema melanops	Spotted sucker	--	--	--	--	--	--	--	--	--
Moxostoma cupiscartes or Scartomyzon sp. ²	Brassy jumprock	--	--	--	--	2	--	--	--	--
Nocomis leptocephalus	Bluehead chub	--	--	3	--	--	8	--	--	1
Notropis cummingsae	Dusky shiner	--	--	--	--	--	--	--	--	--
Notropis procne	Swallowtail shiner	--	--	--	--	--	--	--	--	--
Noturus insignis	Margined madtom	--	--	--	--	--	--	--	--	--
Reptiles										
Chelydra serpentina	Snapping turtle	--	--	--	--	1	--	--	--	--
Trachemys scripta scripta	Yellowbelly Slider	--	--	--	--	--	--	--	--	--
Total Number of Fish:		0	0	11	0	2	23	0	0	4
Total Number of Fish Species:		0	0	4	0	1	5	0	0	2

Table 2-3
Results of Fish and Reptile Species Collected During ARCADIS Spring 2012 Migratory Fish Survey¹

Haile Gold Mine, Inc.
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Scientific Name	Common Name	Location									Overall
		MFS3			MFS3			MFS3			
		Day 1			Day 2			Day 3			
		Electro-fishing	Fyke Net	Eel Trap	Electro-fishing	Fyke Net	Eel Trap	Electro-fishing	Fyke Net	Eel Trap	
First Sampling Event (March 27th - 31st, 2012)											
Migratory Species											
Anguilla rostrata	American Eel	--	--	--	1	--	--	--	--	--	2
Resident Species											
Ameiurus platycephalus	Flat bullhead*	--	--	1	--	--	--	--	--	--	6
Aphredoderus sayanus	Pirate perch	--	--	1	--	--	1	--	--	--	19
Cyprinella chloristia	Greenfin shiner*	--	--	--	--	--	--	--	--	--	8
Erimyzon oblongus	Creek chubsucker	--	--	--	--	--	--	--	--	--	2
Etheostoma olmstedii	Tessellated darter	--	--	--	--	--	--	--	--	--	5
Lepomis auritus	Redbreast sunfish	--	--	--	--	--	--	--	--	--	35
Minytrema melanops	Spotted sucker	--	2	--	--	5	--	--	1	--	8
Moxostoma cupiscartes or Scartomyzon sp. ²	Brassy jumprock	--	--	--	--	--	--	--	--	--	3
Nocomis leptocephalus	Bluehead chub	--	--	--	--	--	--	--	--	--	16
Notropis cummingsae	Dusky shiner	--	--	--	--	--	--	--	--	--	1
Notropis procne	Swallowtail shiner	--	--	--	--	--	--	--	--	--	1
Noturus insignis	Margined madtom	--	--	--	--	--	--	--	--	--	1
Reptiles											
Chelydra serpentina	Snapping turtle	--	--	--	--	--	--	--	--	--	1
Trachemys scripta scripta	Yellowbelly Slider	--	--	--	--	--	--	--	--	--	1
Total Number of Fish:		0	2	2	1	5	1	0	1	0	107
Total Number of Fish Species:		0	1	2	1	1	1	0	1	0	13

Table 2-3
Results of Fish and Reptile Species Collected During ARCADIS Spring 2012 Migratory Fish Survey¹

Haile Gold Mine, Inc.
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Scientific Name	Common Name	Location								
		MFS1								
		Day 1			Day 2			Day 3		
		Electro-fishing	Fyke Net	Eel Trap	Electro-fishing	Fyke Net	Eel Trap	Electro-fishing	Fyke Net	Eel Trap
Second Sampling Event (April 16 th - 19 th , 2012)										
Migratory Species										
<i>Anguilla rostrata</i>	American Eel	--	--	--	1	--	--	--	--	--
Resident Species										
<i>Cyprinella chloristia</i>	Greenfin shiner*	--	--	58	--	--	2	--	--	--
<i>Notropis Petersonii</i>	Coastal Shiner	--	--	--	--	--	--	--	--	--
<i>Nocomis leptocephalus</i>	Bluehead chub	--	--	46	--	--	14	--	--	22
<i>Notropis altipinnis</i>	Highfin shiner	--	--	68	--	--	5	--	--	4
<i>Notropis chlorocephalus</i>	Greenhead shiner*	--	--	--	--	--	--	--	--	--
<i>Notropis procne</i>	Swallowtail shiner	--	--	30	--	--	1	--	--	--
<i>Ameiurus melas</i>	Black bullhead	--	--	--	--	--	--	--	--	--
<i>Erimyzon oblongus</i>	Creek chubsucker	--	--	--	--	--	--	--	--	--
<i>Ameiurus platycephalus</i>	Flat bullhead*	--	--	--	--	--	--	--	--	--
<i>Noturus gyrinus</i>	Tadpole madtom	--	--	--	--	--	--	--	--	--
<i>Noturus insignis</i>	Margined madtom	--	--	--	--	--	--	--	--	--
<i>Esox americanus</i>	Redfin pickerel	--	--	--	--	--	--	--	--	--
<i>Aphredoderus sayanus</i>	Pirate perch	--	--	6	--	--	1	--	--	2
<i>Gambusia holbrooki</i>	Eastern mosquitofish	--	--	--	--	--	--	--	--	1
<i>Lepomis auritus</i>	Redbreast sunfish	--	--	33	--	--	26	--	--	9
<i>Lepomis cyanellus</i>	Green sunfish	--	--	1	--	--	--	--	--	--
<i>Etheostoma olmstedii</i>	Tessellated darter	--	--	2	--	--	3	--	--	2
Reptiles										
<i>Trachemys scripta scripta</i>	Yellowbelly Slider	--	1	--	--	--	--	--	--	--
Total Number of Fish:		0	0	244	1	0	52	0	0	40
Total Number of Fish Species:		0	0	8	1	0	7	0	0	6

Table 2-3
Results of Fish and Reptile Species Collected During ARCADIS Spring 2012 Migratory Fish Survey¹

Haile Gold Mine, Inc.
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Scientific Name	Common Name	Location								
		MFS2								
		Day 1			Day 2			Day 3		
		Electro-fishing	Fyke Net	Eel Trap	Electro-fishing	Fyke Net	Eel Trap	Electro-fishing	Fyke Net	Eel Trap
Second Sampling Event (April 16 th - 19 th , 2012)										
Migratory Species										
Anguilla rostrata	American Eel	--	--	--	--	--	--	--	--	--
Resident Species										
Cyprinella chloristia	Greenfin shiner*	--	--	59	--	--	30	--	--	47
Notropis Petersonii	Coastal Shiner	--	--	1	--	--	3	--	--	--
Nocomis leptocephalus	Bluehead chub	--	--	57	--	--	29	--	--	9
Notropis altipinnis	Highfin shiner	--	--	--	--	--	--	--	--	--
Notropis chlorocephalus	Greenhead shiner*	--	--	7	--	--	2	--	--	--
Notropis procne	Swallowtail shiner	--	--	--	--	--	1	--	--	--
Ameiurus melas	Black bullhead	--	--	--	--	--	--	--	--	--
Erimyzon oblongus	Creek chubsucker	--	--	--	--	--	1	--	--	--
Ameiurus platycephalus	Flat bullhead*	--	--	--	--	--	--	--	--	--
Noturus gyrinus	Tadpole madtom	--	--	--	--	--	--	--	--	--
Noturus insignis	Margined madtom	--	--	2	--	--	--	--	--	1
Esox americanus	Redfin pickerel	--	--	--	--	--	1	--	--	--
Aphredoderus sayanus	Pirate perch	--	--	3	--	--	--	--	--	1
Gambusia holbrooki	Eastern mosquitofish	--	--	--	--	--	--	--	--	--
Lepomis auritus	Redbreast sunfish	--	--	6	--	--	1	--	--	1
Lepomis cyanellus	Green sunfish	--	--	--	--	--	--	--	--	--
Etheostoma olmstedii	Tessellated darter	--	--	--	--	--	1	--	--	--
Reptiles										
Trachemys scripta scripta	Yellowbelly Slider	--	1	--	--	--	--	--	--	--
Total Number of Fish:		0	0	135	0	0	69	0	0	59
Total Number of Fish Species:		0	0	7	0	0	9	0	0	5

Table 2-3
Results of Fish and Reptile Species Collected During ARCADIS Spring 2012 Migratory Fish Survey¹

Haile Gold Mine, Inc.
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Scientific Name	Common Name	Location									Overall
		MFS3			MFS3			MFS3			
		Day 1			Day 2			Day 3			
		Electro-fishing	Fyke Net	Eel Trap	Electro-fishing	Fyke Net	Eel Trap	Electro-fishing	Fyke Net	Eel Trap	
Second Sampling Event (April 16 th - 19 th , 2012)											
Migratory Species											
Anguilla rostrata	American Eel	1	--	--	2	--	--	1	--	--	5
Resident Species											
Cyprinella chloristia	Greenfin shiner*	--	--	--	--	--	--	--	--	--	196
Notropis Petersonii	Coastal Shiner	--	--	3	--	--	--	--	--	--	7
Nocomis leptocephalus	Bluehead chub	--	--	--	--	--	--	--	--	--	177
Notropis altipinnis	Highfin shiner	--	--	--	--	--	--	--	--	--	77
Notropis chlorocephalus	Greenhead shiner*	--	--	--	--	--	--	--	--	--	9
Notropis procne	Swallowtail shiner	--	--	--	--	--	--	--	--	--	32
Ameiurus melas	Black bullhead	--	1	--	--	--	--	--	--	--	1
Erimyzon oblongus	Creek chubsucker	--	--	--	--	--	--	--	--	--	1
Ameiurus platycephalus	Flat bullhead*	--	--	--	--	--	1	--	--	--	1
Noturus gyrinus	Tadpole madtom	--	--	--	--	--	2	--	--	--	2
Noturus insignis	Margined madtom	--	--	--	--	--	--	--	--	--	3
Esox americanus	Redfin pickerel	--	--	--	--	--	--	--	--	--	1
Aphredoderus sayanus	Pirate perch	--	--	--	--	--	--	--	--	--	13
Gambusia holbrooki	Eastern mosquitofish	--	--	--	--	--	--	--	--	--	1
Lepomis auritus	Redbreast sunfish	--	--	--	--	--	--	--	--	--	76
Lepomis cyanellus	Green sunfish	--	--	--	--	--	--	--	--	--	1
Etheostoma olmstedii	Tessellated darter	--	--	--	--	--	--	--	--	--	8
Reptiles											
Trachemys scripta scripta	Yellowbelly Slider	--	--	--	--	--	--	--	--	--	2
Total Number of Fish:		1	1	3	2	0	3	1	0	0	611
Total Number of Fish Species:		1	1	1	1	0	2	1	0	0	18

Table 2-3
Results of Fish and Reptile Species Collected During ARCADIS Spring 2012 Migratory Fish Survey¹

Haile Gold Mine, Inc.
Lancaster County, SC
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Abbreviations:

* = South Carolina Priority Fish Species

MFS = Migratory Fish Survey

Notes:

¹ Locations MFS4 through MFS6 are not presented because no resident fish were observed during electrofishing. Fyke nets and eel traps were not set at these locations because electrofishing was the primary effective method of capture utilized during the study.

² Name is unresolved.

Table 3-1
Physical Measurements Collected During the Habitat Surveys

Haile Gold Mine, Inc.
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Parameter	Locations					
	HGMC3	HGMC4	HGMC5	CB4	CB5	CB6
Wetted width (ft)	4.5	6.1	15.4	11.1	5.7	8.9
Reach Length (ft)	328	328	174	328	328	328
Reach Area (mile ²)	5.3E-05	7.2E-05	9.6E-05	1.3E-04	6.7E-05	1.0E-04
Depth (ft)	0.36	0.92	1.8	0.66	0.39	0.47
Flow Velocity (ft/s)	0.72	0.68	0.46	0.79	0.67	0.89
LWD Density (ft ² /mile ²)	1.0E+06	3.1E+05	5.3E+05	4.7E+05	3.3E+04	1.3E+06

Notes:

BC = Buffalo Creek

CB = Camp Branch

HGMC = Haile Gold Mine Creek

ft = feet

ft²/mile² = square feet per square mile

ft/s = feet per second

mile² = square miles

Table 3-2
Water Quality Measurements Collected During the Habitat Surveys

Haile Gold Mine, Inc.
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Water Quality Parameter ¹	Locations					
	HGMC3	HGMC4	HGMC5	CB4	CB5	CB6
Temperature (°F)	65.17	65.30	71.51	66.51	62.10	69.31
pH	3.78	4.15	4.58	5.46	5.87	6.21
Specific Conductivity (mS/cm)	0.028	0.019	0.022	0.021	0.022	0.025
Turbidity (NTU)	NA	6.6	7.6	7.5	14.4	12.3
Dissolved Oxygen (ppm)	8.29	9.66	8.84	9.13	9.62	8.78
Total Dissolved Solids (%)	0.0018	0.0014	0.0015	0.0015	0.0017	0.0018
ORP (mV)	NA	NA	NA	NA	NA	NA

Notes:

¹ Water quality parameters measured in the field using a YSI 650 MDS multi-parameter probe meter.

% = percent

°F= degrees Fahrenheit

mS/cm = milliSiemens per centimeter

mV = millivolts

ppm = parts per million

NA = Not available

CB = Camp Branch

HGMC = Haile Gold Mine Creek

Table 3-3
Summary of RBP Habitat Assessment Scores for Low-Gradient Streams

Haile Gold Mine, Inc.
Lancaster County, SC
Spring 2012 Aquatic Resource Surveys Report

Sample Reach	Epifaunal Substrate	Pool Substrate Characterization	Pool Variability	Sediment Deposition	Channel Flow Status	Channel Alteration	Channel Sinuosity	Bank Stability		Vegetative Protection		Riparian Vegetative Zone Width		Total
								left bank	right bank	left bank	right bank	left bank	right bank	
Haile Gold Mine Creek														
HGMC3	13	13	5	14	12	20	15	10	10	10	10	10	10	152
HGMC4	8	13	9	9	20	20	14	9	10	10	10	6	10	148
HGMC5	8	13	10	7	20	20	8	9	9	10	10	10	10	144
Camp Branch														
CB4	11	13	8	7	14	20	10	10	10	10	10	10	10	143
CB5	13	12	5	9	11	20	11	4	6	8	8	9	6	122
CB6	16	16	7	10	12	20	13	5	5	8	8	10	10	140

Table 4-1
Summary of ARCADIS Spring 2012 Resident Fish Survey Locations

Haile Gold Mine, Inc.
Lancaster County, SC
Spring 2012 Aquatic Resource Surveys Report

Survey Location	Survey Reach Coordinates ¹				Survey Reach Measurements	
	Upstream Point		Downstream Point		Mean Wetted Width (ft)	Reach Length (ft)
	Latitude	Longitude	Latitude	Longitude		
BC2	34.59959	-80.497275	34.59885	-80.49597	10.2	328
CB2	34.60053	-80.55556	34.59933	-80.55665	6.0	328
CB3	34.59123	-80.567419	34.59021	-80.56815	10.6	328
CB4	34.61083	-80.55447	34.61013	-80.55411	11.1	328
CB5	34.60878	-80.55389	34.60819	-80.55320	5.7	328
CB6	34.60510	-80.55311	34.60430	-80.55345	8.9	328
HGMC1	34.59241	-80.51999	34.591473	-80.521625	2.8	328
HGMC2	34.57375	-80.54306	34.57306	-80.54369	5.6	328
HGMC3	34.58947	-80.52463	34.58884	-80.52544	4.5	328
HGMC4	34.58482	-80.53136	34.58415	-80.53170	6.1	328
HGMC5	34.58173	-80.53328	34.58143	-80.53366	15.4	174
LLR1	34.58569	-80.57916	34.58525	-80.57701	19.0	564
LLR2	34.58177	-80.57088	34.57973	-80.57031	24	715
LLR4	34.55925	-80.55063	34.55715	-80.54955	25.6	768
UT1	34.57389	-80.5217	34.57382	-80.52272	4.6	328

Abbreviations:

BC = Buffalo Creek

CB = Camp Branch

ft = feet

HGMC = Haile Gold Mine Creek

LLR = Little Lynches River

UT = Unnamed Tributary

Notes:

¹ Sample coordinates are in decimal degrees, based on NAD83 reference datum.

Table 4-2
Stream Flow and Water Quality Parameters Measured During ARCADIS Spring 2012 Resident Fish Survey

Haile Gold Mine, Inc.
Lancaster County, SC
Spring 2012 Aquatic Resource Surveys Report

Location	Stream Flow ¹ (ft/s)	Water Quality Parameters ²					
		Temperature (°F)	pH	Specific Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (ppm)	Total Dissolved Solids
BC2	0.82	62.17	4.78	0.020	6.6	10.08	0.0015
CB2	1.3	72.14	6.35	0.027	19.2	8.68	0.0019
CB3	1.1	63.34	6.51	0.032	17.1	9.90	0.0024
CB4	0.62	63.70	5.52	0.019	16.4	7.33	0.0014
CB5	0.79	68.25	5.70	0.023	24.2	9.35	0.0016
CB6	1.4	72.73	6.27	0.024	12.6	8.86	0.0017
HGMC1	0.69	59.34	4.10	0.032	18.9	6.23	0.0025
HGMC2	1.9	65.21	5.09	0.079	9.5	10.56	0.0059
HGMC3	0.72	58.95	4.22	0.026	20.3	8.75	0.0021
HGMC4	1.2	58.91	4.34	0.022	9.5	10.20	0.0018
HGMC5	0.85	62.89	4.45	0.024	7.1	10.09	0.0018
LLR1	1.3	63.57	6.57	0.080	13.3	11.53	0.0061
LLR2	1.7	53.58	6.68	0.059	7.5	10.67	0.0051
LLR4	0.85	55.36	6.83	0.066	8.0	10.76	0.0056
UT1	0.69	57.78	4.32	0.020	2.5	9.39	0.0016

Abbreviations:

% = percentage

°F = degrees Fahrenheit

BC = Buffalo Creek

CB = Camp Branch

HGMC = Haile Gold Mine Creek

LLR = Little Lynches River

mS/cm = milliSiemens per centimeter

NTU = nephelometric turbidity units

ppm = parts per million

Notes:

¹ Stream flow measured in the field using a Marsh-McBirney™ flow meter.

² Water quality parameters measured in the field using a YSI 650 MDS multi-parameter probe meter.

Table 4-3
Species and Number of Individuals Surveyed During ARCADIS Spring 2012 Resident Fish Survey

Haile Gold Mine, Inc.
Lancaster County, SC
Spring 2012 Aquatic Resource Surveys Report

Scientific Name	Common Name	Locations															Species Total
		BC2 Count	CB2 Count	CB3 Count	CB4 Count	CB5 Count	CB6 Count	HGMC1 Count	HGMC2 Count	HGMC3 Count	HGMC4 Count	HGMC5 Count	LLR1 Count	LLR2 Count	LLR4 Count	UT1 Count	
<i>Acantharchus pomotis</i>	Mud sunfish*	--	--	--	--	--	--	--	--	--	2	2	--	--	--	--	4
<i>Ameiurus natalis</i>	Yellow bullhead	1	--	--	--	--	--	--	1	--	--	--	--	--	--	--	2
<i>Ameiurus platycephalus</i>	Flat bullhead*	--	--	--	--	--	--	--	--	--	--	--	3	--	2	--	5
<i>Aphredoderus sayanus</i>	Pirate perch	7	7	5	15	--	1	--	--	--	1	56	9	10	7	5	123
<i>Clinostomus funduloides</i>	Rosyside dace	--	100	36	--	--	57	--	--	--	--	--	1	--	--	--	194
<i>Cyprinella chloristia</i>	Greenfin shiner*	--	--	--	--	--	--	--	--	--	--	--	64	--	10	--	74
<i>Erimyzon oblongus</i>	Creek chubsucker	2	--	7	7	--	4	--	--	--	--	--	--	--	4	--	24
<i>Esox americanus</i>	Redfin pickerel	4	--	--	--	--	--	--	--	--	--	--	--	--	2	--	6
<i>Etheostoma olmstedii</i>	Tessellated darter	--	4	9	--	2	3	--	--	--	--	--	25	32	19	--	94
<i>Gambusia holbrooki</i>	Eastern mosquitofish	--	--	--	--	--	--	--	--	--	--	--	--	2	4	--	6
<i>Lepomis auritus</i>	Redbreast sunfish	--	32	21	31	2	9	--	--	--	--	--	46	86	43	--	270
<i>Lepomis cyanellus</i>	Green sunfish	--	1	2	18	3	3	--	--	--	--	--	2	7	2	--	38
<i>Lepomis gibbosus</i>	Pumpkinseed	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	3
<i>Lepomis macrochirus</i>	Bluegill	--	--	--	--	--	--	--	--	--	--	4	3	2	6	--	15
<i>Lepomis marginatus</i>	Dollar sunfish	--	--	--	--	--	--	--	--	--	--	--	3	1	--	--	4
<i>Micropterus salmoides</i>	Largemouth bass	--	--	--	--	--	--	--	--	--	--	--	1	--	3	--	4
<i>Moxostoma cupiscartes</i> or <i>Scartomyzon</i> sp. ¹	Brassy jumprock	--	--	--	--	--	--	--	--	--	--	--	--	--	5	--	5
<i>Nocomis leptocephalus</i>	Bluehead chub	--	52	70	--	1	12	--	--	--	--	--	24	2	29	--	190
<i>Notemigonus crysoleucas</i>	Golden shiner	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	1
<i>Notropis altipinnis</i>	Highfin shiner	--	--	--	--	--	--	--	--	--	--	--	62	822	58	--	942
<i>Notropis chlorocephalus</i>	Greenhead shiner*	--	24	2	--	--	--	--	--	--	--	--	--	--	1	--	27
<i>Notropis cummingsae</i>	Dusky shiner	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	3
<i>Notropis procerus</i>	Swallowtail shiner	--	--	--	--	--	--	--	--	--	--	--	51	68	26	--	145
<i>Noturus insignis</i>	Margined madtom	--	10	3	--	--	--	--	--	--	--	--	2	--	2	--	17
<i>Perca flavescens</i>	Yellow perch	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	1
<i>Percina crassa</i>	Piedmont darter*	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	2
<i>Semotilus atromaculatus</i>	Creek chub	--	22	34	13	13	13	--	--	--	--	--	--	--	--	--	95
<i>Semotilus lumbee</i>	Sandhills chub*	14	--	--	--	--	--	--	--	60	51	22	--	--	--	42	189
Total Number of Fish:		28	252	189	84	21	102	0	1	60	54	84	296	1033	232	47	2483
Total Number of Species:		5	9	10	5	5	8	0	1	1	3	4	14	11	21	2	28

Abbreviations:

-- = Not observed

* = South Carolina Priority Fish Species

BC = Buffalo Creek

CB = Camp Branch

HGMC = Haile Gold Mine Creek

LLR = Little Lynches River

UT = Unnamed Tributary

Notes:

¹ Name unresolved.

Table 4-4
Trophic Group Composition of Fish Surveyed During ARCADIS Spring 2012 Resident Fish Survey

Haile Gold Mine, Inc.
Lancaster County, SC
Spring 2012 Aquatic Resource Surveys Report

Trophic Group ¹	Locations															Overall
	BC2	CB2	CB3	CB4	CB5	CB6	HGMC1	HGMC2	HGMC3	HGMC4	HGMC5	LLR1	LLR2	LLR4	UT1	
% Predator	14.3	0	0	0	0	0	NA	0	0	0	0	0.3	0	2.6	0	0.4
% Omnivore	10.7	20.6	40.7	8.3	4.8	15.7	NA	100	0	0	0	8.1	0.3	14.2	0	8.7
% Insectivore	75.0	79.4	59.3	91.7	95.2	84.3	NA	0	100	100	100	91.6	99.7	83.2	100	90.8

Abbreviations:

BC = Buffalo Creek

CB = Camp Branch

HGMC = Haile Gold Mine Creek

NA = Not applicable

LLR = Little Lynches River

UT = Unnamed Tributary

Notes:

¹ Trophic group assignments are based on those found in Table 4 of: (NCDENR, 2006) *Standard Operating Procedure Biological Monitoring - Stream Fish Community Assessment Program*. North Carolina Department of Environment and Natural Resources, Division of Water Quality, Environmental Sciences Section, Biological Assessment Unit. August 1, 2006. 51 pp.

Table 4-5
Relative Abundance¹ of Fish Observed During ARCADIS Spring 2012 Resident Fish Survey

Haile Gold Mine, Inc.
Lancaster County, SC
Spring 2012 Aquatic Resource Surveys Report

Scientific Name	Common Name	Locations															Overall
		BC2	CB2	CB3	CB4	CB5	CB6	HGMC1	HGMC2	HGMC3	HGMC4	HGMC5	LLR1	LLR2	LLR4	UT1	
<i>Acantharchus pomotis</i>	Mud sunfish*	--	--	--	--	--	--	--	--	--	3.7	2.4	--	--	--	--	0.16
<i>Ameiurus natalis</i>	Yellow bullhead	3.6	--	--	--	--	--	--	100	--	--	--	--	--	--	--	0.081
<i>Ameiurus platycephalus</i>	Flat bullhead*	--	--	--	--	--	--	--	--	--	--	--	1.0	--	0.86	--	0.20
<i>Aphredoderus sayanus</i>	Pirate perch	25.0	2.8	2.6	17.9	--	0.98	--	--	--	1.9	66.7	3.0	0.97	3.0	10.6	5.0
<i>Clinostomus funduloides</i>	Rosyside dace	--	39.7	19.0	--	--	55.9	--	--	--	--	--	0.34	--	--	--	7.8
<i>Cyprinella chloristia</i>	Greenfin shiner*	--	--	--	--	--	--	--	--	--	--	--	21.6	--	4.3	--	3.0
<i>Erimyzon oblongus</i>	Creek chubsucker	7.1	--	3.7	8.3	--	3.9	--	--	--	--	--	--	--	1.7	--	1.0
<i>Esox americanus</i>	Redfin pickerel	14.3	--	--	--	--	--	--	--	--	--	--	--	--	0.86	--	0.24
<i>Etheostoma olmstedii</i>	Tessellated darter	--	1.6	4.8	--	9.5	2.9	--	--	--	--	--	8.4	3.1	8.2	--	3.8
<i>Gambusia holbrooki</i>	Eastern mosquitofish	--	--	--	--	--	--	--	--	--	--	--	--	0.19	1.7	--	0.24
<i>Lepomis auritus</i>	Redbreast sunfish	--	12.7	11.1	36.9	9.5	8.8	--	--	--	--	--	15.5	8.3	18.5	--	10.9
<i>Lepomis cyanellus</i>	Green sunfish	--	0.40	1.1	21.4	14.3	2.9	--	--	--	--	--	0.68	0.68	0.86	--	1.5
<i>Lepomis gibbosus</i>	Pumpkinseed	--	--	--	--	--	--	--	--	--	--	--	--	--	1.3	--	0.12
<i>Lepomis macrochirus</i>	Bluegill	--	--	--	--	--	--	--	--	--	--	4.8	1.0	0.19	2.6	--	0.60
<i>Lepomis marginatus</i>	Dollar sunfish	--	--	--	--	--	--	--	--	--	--	--	1.0	0.097	--	--	0.16
<i>Micropterus salmoides</i>	Largemouth bass	--	--	--	--	--	--	--	--	--	--	--	0.34	--	1.3	--	0.16
<i>Moxostoma cupiscartes</i> or <i>Scartomyzon</i> sp. ²	Brassy jumprock	--	--	--	--	--	--	--	--	--	--	--	--	--	2.2	--	0.20
<i>Nocomis leptcephalus</i>	Bluehead chub	--	20.6	37.0	--	4.8	11.8	--	--	--	--	--	8.1	0.19	12.5	--	7.7
<i>Notemigonus crysoleucas</i>	Golden shiner	--	--	--	--	--	--	--	--	--	--	--	--	0.097	--	--	0.040
<i>Notropis altipinnis</i>	Highfin shiner	--	--	--	--	--	--	--	--	--	--	--	20.9	79.6	25.0	--	37.9
<i>Notropis chlorocephalus</i>	Greenhead shiner*	--	9.5	1.1	--	--	--	--	--	--	--	--	--	--	0.43	--	1.1
<i>Notropis cummingsae</i>	Dusky shiner	--	--	--	--	--	--	--	--	--	--	--	--	--	1.3	--	0.12
<i>Notropis procne</i>	Swallowtail shiner	--	--	--	--	--	--	--	--	--	--	--	17.2	6.6	11.2	--	5.8
<i>Noturus insignis</i>	Marginated madtom	--	4.0	1.6	--	--	--	--	--	--	--	--	0.68	--	0.86	--	0.68
<i>Perca flavescens</i>	Yellow perch	--	--	--	--	--	--	--	--	--	--	--	--	--	0.43	--	0.040
<i>Percina crassa</i>	Piedmont darter*	--	--	--	--	--	--	--	--	--	--	--	--	--	0.86	--	0.081
<i>Semotilus atromaculatus</i>	Creek chub	--	8.7	18.0	15.5	61.9	12.7	--	--	--	--	--	--	--	--	--	3.8
<i>Semotilus lumbee</i>	Sandhills chub*	50.0	--	--	--	--	--	--	--	100	94.4	26.2	--	--	--	89.4	7.6

Abbreviations:

-- = Not applicable

* = South Carolina Priority Fish Species

BC = Buffalo Creek

CB = Camp Branch

HGMC = Haile Gold Mine Creek

LLR = Little Lynches River

UT = Unnamed Tributary

Notes:

¹ Relative abundance is the percentage of the number of an individual species observed relevant to the total number of fish observed.

² Name is unresolved.

Table 4-6
Diversity¹ and Species Richness² of Fish Observed During ARCADIS Spring
2012 Resident Fish Survey

Haile Gold Mine, Inc.
Lancaster County, SC
Spring 2012 Aquatic Resource Surveys Report

Locations	Species Richness	Diversity (1/D)
BC2	5	3.2
CB2	9	4.3
CB3	10	4.6
CB4	5	4.2
CB5	5	2.5
CB6	8	2.9
HGMC1	0	NA
HGMC2	1	NA
HGMC3	1	1.0
HGMC4	3	1.1
HGMC5	4	2.0
LLR1	14	6.4
LLR2	11	1.5
LLR4	21	7.5
UT1	2	1.2
Overall	28	5.5

Abbreviations:

BC = Buffalo Creek

CB = Camp Branch

HGMC = Haile Gold Mine Creek

LLR = Little Lynches River

NA = Not applicable

UT = Unnamed Tributary

Notes:

¹ Inverse index of diversity (1/D) is based on Simpson's formula:

$$D = \sum_{i=1}^s \left[\frac{n_i(n_i - 1)}{N(N - 1)} \right]$$

² Species richness is equal to total number of species observed.

Table 4-7
South Carolina Priority Fish Species Observed During ARCADIS Spring 2012 Resident Fish Survey

Haile Gold Mine, Inc.
Lancaster County, SC
Spring 2012 Aquatic Resource Surveys Report

Scientific Name	Common Name	Priority Classification ²	Locations															
			BC2	CB2	CB3	CB4	CB5	CB6	HGMC1	HGMC2	HGMC3	HGMC4	HGMC5	LLR1	LLR2	LLR4	UT1	Overall
<i>Cyprinella chloristia</i>	Greenfin shiner	Moderate	--	--	--	--	--	--	--	--	--	--	--	64 (21.6)	--	10 (4.3)	--	74 (3.0)
<i>Notropis chlorocephalus</i>	Greenhead shiner	High	--	24 (9.5)	2 (1.1)	--	--	--	--	--	--	--	--	--	--	1 (0.43)	--	27 (1.1)
<i>Semotilus lumbee</i>	Sandhills chub	Highest	14 (50.0)	--	--	--	--	--	--	--	60 (100)	51 (94.4)	22 (26.2)	--	--	--	42 (89.4)	189 (7.6)
<i>Ameiurus platycephalus</i>	Flat bullhead	Moderate	--	--	--	--	--	--	--	--	--	--	--	3 (1.0)	--	2 (0.86)	--	5 (0.20)
<i>Acantharchus pomotis</i>	Mud sunfish	Moderate	--	--	--	--	--	--	--	--	--	--	--	--	--	2 (0.86)	--	4 (0.16)
<i>Percina crassa</i>	Piedmont darter	High	--	--	--	--	--	--	--	--	--	--	--	--	--	1 (0.86)	--	2 (0.081)

Abbreviations:

-- = Not observed
BC = Buffalo Creek
CB = Camp Branch
HGMC = Haile Gold Mine Creek
LLR = Little Lynches River
UT = Unnamed Tributary

Notes:

¹ For each location, the number observed and the percent relative abundance (in parentheses) for each priority fish species is presented

² Based on criteria presented in Chapter 2 of the SCDNR's 2005 *Comprehensive Wildlife Conservation Strategy* plan document.

Table 4-8
Species Listing and Distribution of Reptiles and Amphibians Observed in Spring 2012.

Haile Gold Mine, Inc.
Lancaster County, SC
Spring 2012 Aquatic Resource Surveys Report

Species	Status	Order	Family	Sampling Location/Stream Reach				
				LLR	HGMC	CB	BC	UT
Frogs/Toads								
Green Tree Frog (<i>Hyla cinerea</i>)	Common	Anura	Hylidae		HGMC4			
Southern Cricket Frog (<i>Acris gryllus gryllus</i>)	Common	Anura	Hylidae		HGMC1	CB6		
Bullfrog (<i>Rana catesbeiana</i>)	Common	Anura	Ranidae		HGMC3			
Green Frog (<i>Rana clamitans clamitans</i>)	Common	Anura	Ranidae	LLR2	HGMC1 HGMC2 HGMC3		BC2	UT1
Southern Leopard Frog (<i>Rana utricularia</i>)	Common	Anura	Ranidae			CB4		UT1
Salamanders								
Two-toed Amphiuma (<i>Amphiuma means</i>)	Common	Caudata	Amphiumidae		HGMC5			
Northern Dusky Salamander (<i>Desmognathus fuscus fuscus</i>)	Common	Caudata	Plethodontidae		HGMC3			
Southern 2-Lined Salamander (<i>Eurycea cirrigera</i>)	Common	Caudata	Plethodontidae	LLR1 LLR2 LLR4	HGMC4	CB6		
Lizards								
Green Anole (<i>Anolis carolinensis</i>)	Common	Squamata	Polychridae	LLR2	HGMC2	CB4		
Snakes								
Northern Water Snake (<i>Nerodia sipedon sipedon</i>)	Common	Squamata	Colubridae			CB5		
Turtles								
Eastern Box Turtle (<i>Terrapene carolina carolina</i>)	Common	Testudines	Emydidae			CB4		
Yellowbelly Slider (<i>Trachemys scripta scripta</i>)	SCDNR High	Testudines	Emydidae	LLR2				

Abbreviations:

BC = Buffalo Creek
CB = Camp Branch
HGMC = Haile Gold Mine Creek
LLR = Little Lynches River
UT = Unnamed Tributary

**Haile Gold Mine, Inc.
Lancaster County, SC
Spring 2012 Aquatic Resource Surveys Report**

Taxa	Species or Family	Stage	Survey Site																	
			BC2	UT1	CB2	CB3	CB4	CB5	CB6	HGMC1	HGMC2	HGMC3	HGMC4	HGMC5	LLR1	LLR2	LLR3	LLR4	LLR6	
Ephemeroptera	<i>Acentrella parvula</i>	N																1		
	<i>Acerpenna pygmaea</i>	N	1																	
	<i>Attenella attenuata</i>	N	19																	
	<i>Baetis flavigastra</i>	N												1		1				
	<i>Baetis intercalaris</i>	N												35		24		10		
	<i>Baetis pluto</i>	N				5														
	<i>Caenis diminuta</i>	N											5	1	10	11	12	8		
	<i>Centroptilum</i> sp.	N			1				2					2	12	5	3			
	<i>Dannella simplex</i>	N	2														1			
	<i>Ephemerella invaria</i>	N			1	4														
	<i>Eurylophella doris/temporalis</i>	N									2	4				2		1		
	<i>Hexagenia limbata</i>	N				1														
	<i>Isonychia</i>	N			47	4			11						24		19	17	67	
	<i>Iswaeon anoka</i>	N													1					
	<i>Labiobaetis frondalis</i>	N	8											2	1	1				
	<i>Labiobaetis propinquus</i>	N			1	1		1	1				2				1	8	3	
	<i>Leptophlebia</i> nr. <i>intermedia</i>	N	5																	
	<i>Leucrocuta</i> nr. <i>aphrodite</i>	N													3					
	<i>Maccaffertium modestum</i>	N	9	1	1	17							23	2	3		2	1	1	
	<i>Maccaffertium</i> nr. <i>pudicum</i>	N											1							
	<i>Macdunnoa brunnea</i>	N																	1	
	<i>Paraleptophlebia</i>	N	2																	
	<i>Plauditus</i> nr. <i>punctiventris</i>	N															1			
	<i>Stenacron interpunctatum</i>	N													1		1			
	<i>Teloganopsis deficiens</i>	N				1														
	Plecoptera	<i>Alloperla</i> sp.	N	2		2														
		<i>Amphinemura delosa</i>	N	2																
<i>Eccoptura xanthenes</i>		N		1		2						2								
<i>Isoperla bilineata</i>		N	2		5	5		1	1									1		
<i>Isoperla dicala</i>		N														2	1			
<i>Leuctra</i>		N	13	61					3	3		63	22	17						
<i>Perlesta</i> sp.		N	94	16	52	3		55	48			31	7	2	39		32	35	89	
Trichoptera	<i>Anisocentropus pyraloides</i>	L		30									1							
	<i>Cheumatopsyche</i>	L	1		17	23		10	7		8				43		8	2	10	
	<i>Diplectrona modesta</i>	L		3								4	1	1						
	<i>Heteroplectron americanum</i>	P										6								
	<i>Hydropsyche betteni</i>	L				1														
	<i>Lepidostoma</i> sp.	L		2				3				1	3							
	<i>Neophylax</i> sp.	L	3																	
	<i>Oxyethira</i>	L												4						
	<i>Philocentropus</i> sp.	L														5		4		
	<i>Psilotreta frontalis</i>	L		7	2															
	<i>Ptilostomis</i> sp.	L								1										
	<i>Pycnopsyche luculenta/sonso</i>	L	3	2	5				4			3	3					2		
	<i>Trienodes ignitus</i>	L		1									2							
	a	<i>Argia sedula</i>	N												21			1		
<i>Argia tibialis</i>		N																2		
<i>Boyeria vinosa</i>		N	4		2			1	2			1	4		3	1	2	8	4	
<i>Calopteryx dimidiata</i>		N	1	2								9	12	8						
<i>Cordulegaster bilineata</i>		N	5	2	1	3		3	1	3		3	2							
<i>Enallagma basidens</i>		N												1						
<i>Enallagma divagans</i>		N												2		1				
<i>Enallagma</i> sp.		N													4					
<i>Erythemis simplicicollis</i>		N															1			

Table 5-2
Species Collected During the ETT - ARCADIS 2012 Benthic Macroinvertebrate Survey

**Haile Gold Mine, Inc.
Lancaster County, SC
Spring 2012 Aquatic Resource Surveys Report**

Taxa	Species or Family	Stage	Survey Site																	
			BC2	UT1	CB2	CB3	CB4	CB5	CB6	HGMC1	HGMC2	HGMC3	HGMC4	HGMC5	LLR1	LLR2	LLR3	LLR4	LLR6	
Odonata	<i>Gomphus lividus</i>	N				4			2				3				2	5	1	
	<i>Hagenius brevistylus</i>	N										2					1			
	<i>Helocordulia selysii</i>	N	1																	
	<i>Ischnura</i> sp.	N				2						1								
	<i>Libellula</i>	N				2														
	<i>Macromia illinoense</i>	N															2	4		
	<i>Neurocordulia</i> sp.	N				1														
	<i>Ophiogomphus mainensis</i>	N				2												1		
	<i>Progomphus obscurus</i>	N	3			1						12						6		
	<i>Somatochlora</i> sp.	N	1			1														
	<i>Sympetrum</i>	N			1				1											
Heteroptera	<i>Gerris conformis</i>	A						2	1											
	<i>Limnoporus</i> sp.	N					4													
	<i>Notonecta</i>	A					11													
	<i>Ranatra buenoi</i>	N													1					
	<i>Trichocorixa calva</i>	A					6	5							10	2	7			
Megaloptera	<i>Corydalus cornutus</i>	L				1														
	<i>Nigronia fasciatus</i>	L		1																
	<i>Nigronia serricornis</i>	L		1		2						2	1			1				
	<i>Sialis</i>	L			1	3									1		2			
Coleoptera	<i>Ancyronyx variegatus</i>	L, A	2										3				3	1		
	<i>Berosus</i> sp.	L									2				4	2				
	<i>Dineutus ciliatus</i>	A				1					1					1	1			
	<i>Dineutus discolor</i>	A																4		
	<i>Dineutus</i> sp.	L					2				2				3		3	7	5	
	<i>Dubiraphia</i> sp.	L													1	4				
	<i>Dubiraphia vittata</i>	A										2					2			
	<i>Ectopria nervosa</i>	L				2														
	<i>Enochrus</i> sp.	A															1			
	<i>Helichus</i> sp.	A	1												1		2			
	<i>Hydroporus</i> sp. 2	A																1		
	<i>Hydroporus/Neoporus</i> sp.	L							1							3				
	<i>Macronychus glabratus</i>	L, A				1											2	2	2	
	<i>Neoporus clypealis</i>	A	20		2		12		9	1		1		1	2	24	4	5	1	
	<i>Neoporus</i> sp. 2	A	1				1	1		1	1									
	<i>Peltodytes</i> sp.	A														2				
	<i>Scirtes</i>	L																		
	<i>Sperchopsis tessellatus</i>	L, A	2	1			5								2			1		
	<i>Stenelmis</i>	L						1					2							
	<i>Stenelmis sinuata</i>	A	4	1									1	1						
	<i>Stenelmis</i> sp.	L, A				1			5		2				1					
<i>Tropisternus</i> sp.	L															2	1			
a - Excluding midges	<i>Anopheles</i> sp.	L														3		1		
	<i>Antocha</i> sp.	L				1														
	<i>Bezzia</i> sp.	L			1			2			3				2	1		1		
	<i>Bittacomorpha clavipes</i>	L					1													
	<i>Crysops</i>	L					1													
	<i>Dicranota</i> sp.	L										1								
	Ephydriidae	L														1				
	<i>Hexatoma</i> sp.	L				4			1				1		5					
	<i>Limnophila (Eleophila)</i> sp.	L		2																
	<i>Pilaria</i>	L											1		1					
	<i>Simulium</i> sp.	L	3		2	2		21		1										

Table 5-2
Species Collected During the ETT - ARCADIS 2012 Benthic Macroinvertebrate Survey

Haile Gold Mine, Inc.
Lancaster County, SC
Spring 2012 Aquatic Resource Surveys Report

Taxa	Species or Family	Stage	Survey Site																
			BC2	UT1	CB2	CB3	CB4	CB5	CB6	HGMC1	HGMC2	HGMC3	HGMC4	HGMC5	LLR1	LLR2	LLR3	LLR4	LLR6
Diptera	<i>Simulium tuberosum</i> gp.	L										1	6	24	94	2	4		
	<i>Simulium venustum</i>	L									1								
	<i>Stilobezzia</i>	L					1			1									
	<i>Tipula</i> (N.) abdominalis	L			2				2								1		
	<i>Tipula</i> (Yamato.) sp.	L										8							
	<i>Tipula</i> sp.	L	1		2	5		1	1		2	1					8	2	3
Diptera - Midge only	<i>Ablabesmyia mallochi</i>	L	2			6						1	24	12	26	6	5	9	
	<i>Brillia flavifrons</i>	L	1			1		1											
	<i>Chaetocladius dentiforceps</i>	L											20						
	<i>Chironomus</i>	L				2	5								34				
	<i>Clinotanypus pinguis</i>	L						1						2	3				
	<i>Conchapelopia</i> gp.	L	33	27	17	2		25	25		16	20	38	324	54		6	3	3
	<i>Corynoneura</i> sp.	L																	1
	<i>Cricotopus bicinctus</i>	L												6			4		
	<i>Cricotopus</i> nr. vierriensis	L									8		1						
	<i>Cryptochironomus fulvus</i> gp.	L				2		1	1		4						2	1	
	<i>Dicrotendipes neomodestus</i>	L					1									5			
	<i>Labrundinia pilosella</i>	L	7																
	<i>Microtendipes pedellus</i>	L																	1
	<i>Orthocladius annectens</i>	L					1	3											
	<i>Parachaetocladius</i> sp.	L						1											
	<i>Paracladopelma</i> sp.	L				1		1											
	<i>Paralauterborniella</i>	L				3													
	<i>Parametrioctenemus</i> sp.	L	3		4	8		4	11						48		3	3	1
	<i>Paratanytarsus</i> sp.	L						1							4		3	1	
	<i>Paratendipes albimanus</i>	L										1							
	<i>Phaenopsectra flavipes</i>	L	1												2	1			1
	<i>Polypedilum aviceps</i>	L	7		7	3		2	10						110		37		14
	<i>Polypedilum illinoense</i> gp.	L				12	2		1	2	12	4	2			22		5	
	<i>Procladius</i> sp.	L					4	1		3					18	10	3	2	
	<i>Psectrocladius simulans</i>	L					1	1	2		1		2	316					
	<i>Rheocricotopus robacki</i>	L	1		3	1		4	3	1			1				2		5
	<i>Rheotanytarsus exiguus</i>	L	1		1				3						1		1		2
	<i>Rheotanytarsus</i> nr pellucidus	L													6		1		5
	<i>Stempellinella</i> sp.	L	1																
	<i>Stenochironomus</i>	L		2															
	<i>Synorthocladius semivirens</i>	L													1		2		
	<i>Tanytarsus</i> sp.	L	1	2				1		1			1						
	<i>Tanytarsus</i> sp. C	L							3				2		4				
	<i>Tanytarsus</i> sp. L	L													6	4	8	6	6
	<i>Tanytarsus</i> sp. O	L										2							
	<i>Tanytarsus</i> sp. S	L	5			1													
	<i>Thienemanniella xena</i> gp.	L						1											1
	<i>Tribelos jucundum</i>	L	6							1									
	<i>Tvetenia paucunca</i>	L	1	2															
	<i>Tvetenia vitracies</i>	L															3		4
	<i>Unniella multivirga</i>	L									1								
	<i>Zavreliomyia</i> sp.	L	4		4	2			2			3	2						
	Annelida	<i>Cambarincola</i> sp.	--							2							2		
		Naididae	--					3									2	1	
		Tubificidae (w/o cap. setae)	--								1		1				2		
	Arachnida	<i>Caecidotea</i> sp.	J					3			16		15	8					
Cambarinae		J	2	1		2	1	3		2		1				1			
<i>Cambarus latimanus</i>		J				1													

Table 5-2
Species Collected During the ETT - ARCADIS 2012 Benthic Macroinvertebrate Survey

Haile Gold Mine, Inc.
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Taxa	Species or Family	Stage	Survey Site																
			BC2	UT1	CB2	CB3	CB4	CB5	CB6	HGMC1	HGMC2	HGMC3	HGMC4	HGMC5	LLR1	LLR2	LLR3	LLR4	LLR6
Crustac	<i>Cambarus sp.</i>	J			4		1	1	4										
	<i>Crangonyx obliquus gp.</i>	J														1			
	<i>Crangonyx sp.</i>	J	5	2															
	<i>Hyalolella azteca</i>	J														7	4	1	
	<i>Procambarus sp.</i>	A					1								2				
Mollusca	<i>Corbicula fluminea</i>	Clam				8		4							3	19	6	13	
	<i>Helisoma anceps</i>	Snail													1				
	<i>Lymnaea columella</i>	Snail													2				
	<i>Physa acuta</i>	Snail													22	18	15	1	
	<i>Sphaerium</i>	Clam	4	3	1	3	1		1					1		17	3	2	1
Misc.	Cladocera - <i>Eurycercus</i>	L													3	2			

Notes:

BC = Buffalo Creek
CB = Camp Branch
HGMC = Haile Gold Mine Creek
LLR = Little Lynches River

Table 5-2
Community Assessment Metrics for the ETT - ARCADIS 2012 Benthic Macroinvertebrate Survey

Haile Gold Mine, Inc.
Lancaster County, SC
Spring 2012 Aquatic Resource Surveys Report

Parameters	BC2	UT1	CB2	CB3	CB4	CB5	CB6	HGMC1	HGMC2	HGMC3	HGMC4	HGMC5
Biological Parameter Results												
Taxa Richness	47	24	28	46	24	34	31	15	14	23	36	23
Total No. Organisms / Site	300	173	189	160	72	169	166	38	63	183	174	787
EPT Index	15	10	11	12	0	5	8	2	1	7	12	7
EPT/Chironomid Ratio	2.2	3.8	3.7	1.5	0	1.3	1.4	0.5	0.2	3.7	1.4	0.05
Scraper/Filterer Ratio	1.1	1.1	0.0	0.5	0	0.02	0.3	0	0.2	0	2.7	0.1
Biotic Index	4.9	4.0	5.4	5.9	7.0	5.7	5.0	6.7	7.5	5.4	5.7	6.0
% Dominant Taxon	31%	35%	28%	14%	17%	33%	29%	42%	25%	34%	22%	41%
Shredder/Total No. Organisms Ratio	0.09	0.6	0.08	0.1	0.03	0.04	0.1	0.2	0.3	0.5	0.2	0.02
Water Quality Rating Score												
EPT Score	3.0	2.0	2.0	2.0	1.0	1.0	2.0	1.0	1.0	1.6	2.0	1.6
Biotic Index Score	5.0	5.0	5.0	4.0	2.0	4.0	5.0	2.4	2.0	4.6	4.0	4.0
Mean Score	4.0	3.5	3.5	3.0	1.5	2.5	3.5	1.7	1.5	3.1	3.0	2.8
Bioclassification of Site (Independent)	good	good	good-fair	good-fair	fair	good-fair	good	fair	fair	good-fair	good-fair	good-fair
Aquatic Life Use Support	fully	fully	partially	partially	partially	partially	fully	partially	partially	partially	partially	partially

Notes:

BC = Buffalo Creek

CB = Camp Branch

HGMC = Haile Gold Mine Creek

LLR = Little Lynches River

UT = Unnamed Tributary

Table 5-2
Community Assessment Metrics for the ETT - ARCADIS 2012 Benthic Macroinvertebrate Survey

Haile Gold Mine, Inc.
Lancaster County, SC
Spring 2012 Aquatic Resource Surveys Report

Parameters	LLR1	LLR2	LLR3	LLR4	LLR6
Biological Parameter Results					
Taxa Richness	44	37	50	39	37
Total No. Organisms / Site	580	264	259	180	278
EPT Index	12	4	13	11	11
EPT/Chironomid Ratio	0.6	0.3	1.3	3.3	3.6
Scraper/Filterer Ratio	0.2	0.4	0.4	0.05	0.03
Biotic Index	5.9	7.2	5.8	5.5	5.3
% Dominant Taxon	19%	13%	14%	19%	32%
Shredder/Total No. Organisms Ratio	0.2	0.08	0.2	0.04	0.07
Water Quality Rating Score					
EPT Score	2.0	1.0	2.4	2.0	2.0
Biotic Index Score	4.0	2.0	4.0	4.0	5.0
Mean Score	3.0	1.5	3.2	3.0	3.5
Bioclassification of Site (Independent)	good-fair	fair	good-fair	good-fair	good-fair
Aquatic Life Use Support	partially	partially	partially	partially	partially

Notes:

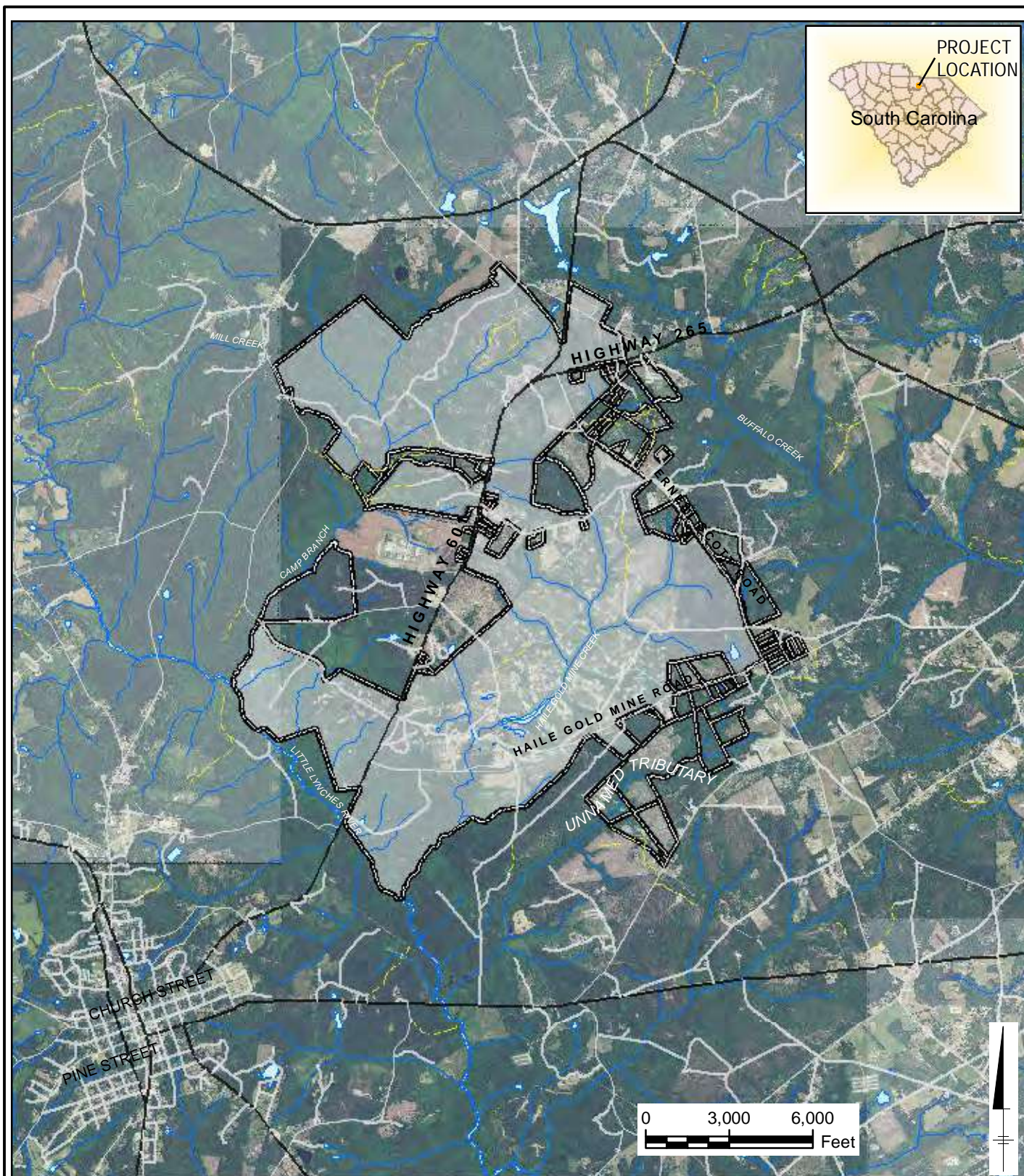
BC = Buffalo Creek
CB = Camp Branch
HGMC = Haile Gold Mine Creek
LLR = Little Lynches River
UT = Unnamed Tributary



Haile Gold Mine

Spring 2012 Aquatic
Resource Surveys Report

Figures



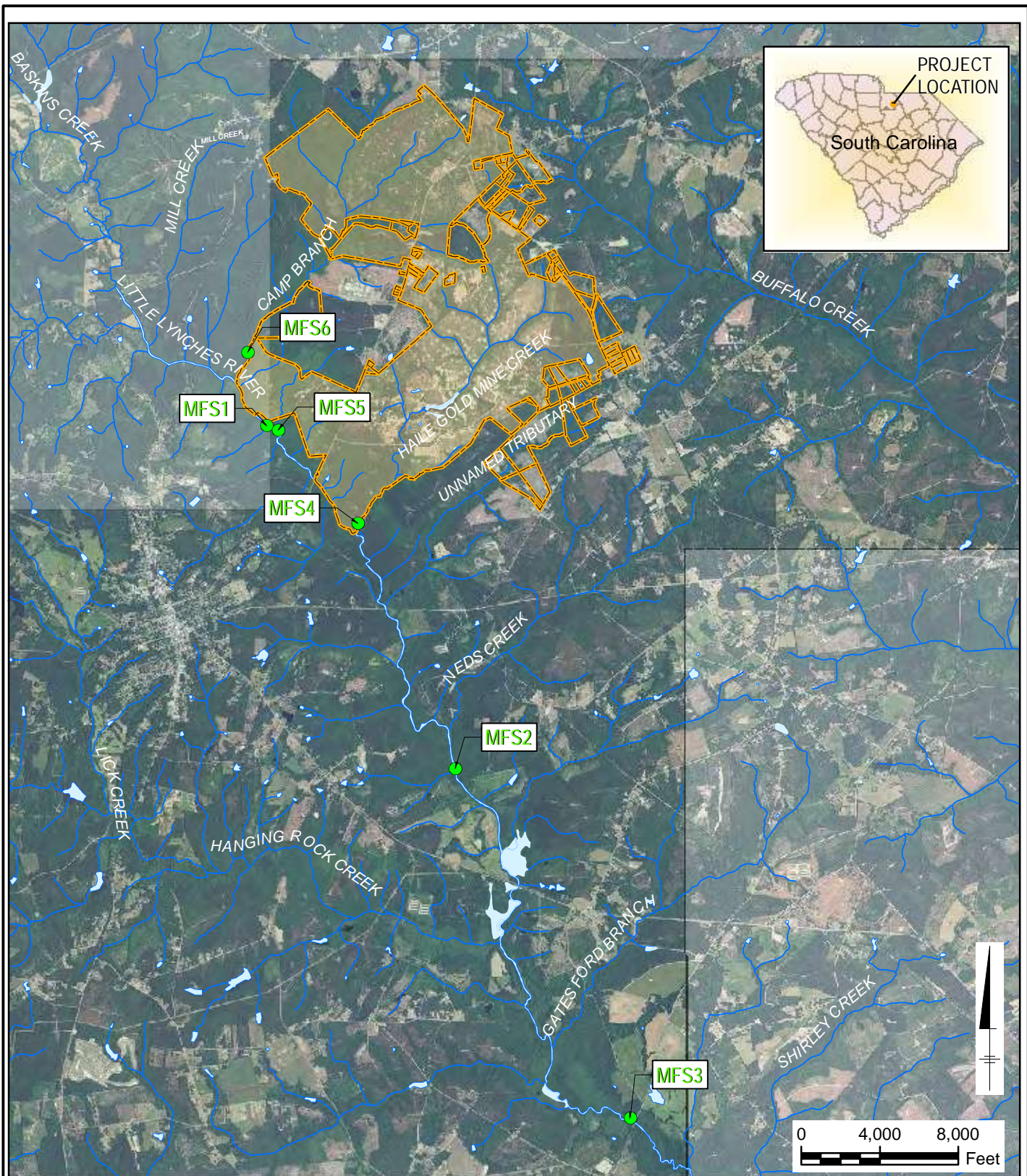
- Property Boundary
- Permit Boundary
- Primary Roads
- Streets
- Secondary Roads
- Trails

HAILE GOLD MINE, INC.
**SPRING 2012 AQUATIC RESOURCE
 SURVEYS REPORT**

GENERAL STUDY AREA



FIGURE
1-1



● Migratory Fish Survey Locations

— Property Boundary

Permit Boundary

NOTE: Survey locations are marked at the approximate middle of the reach.

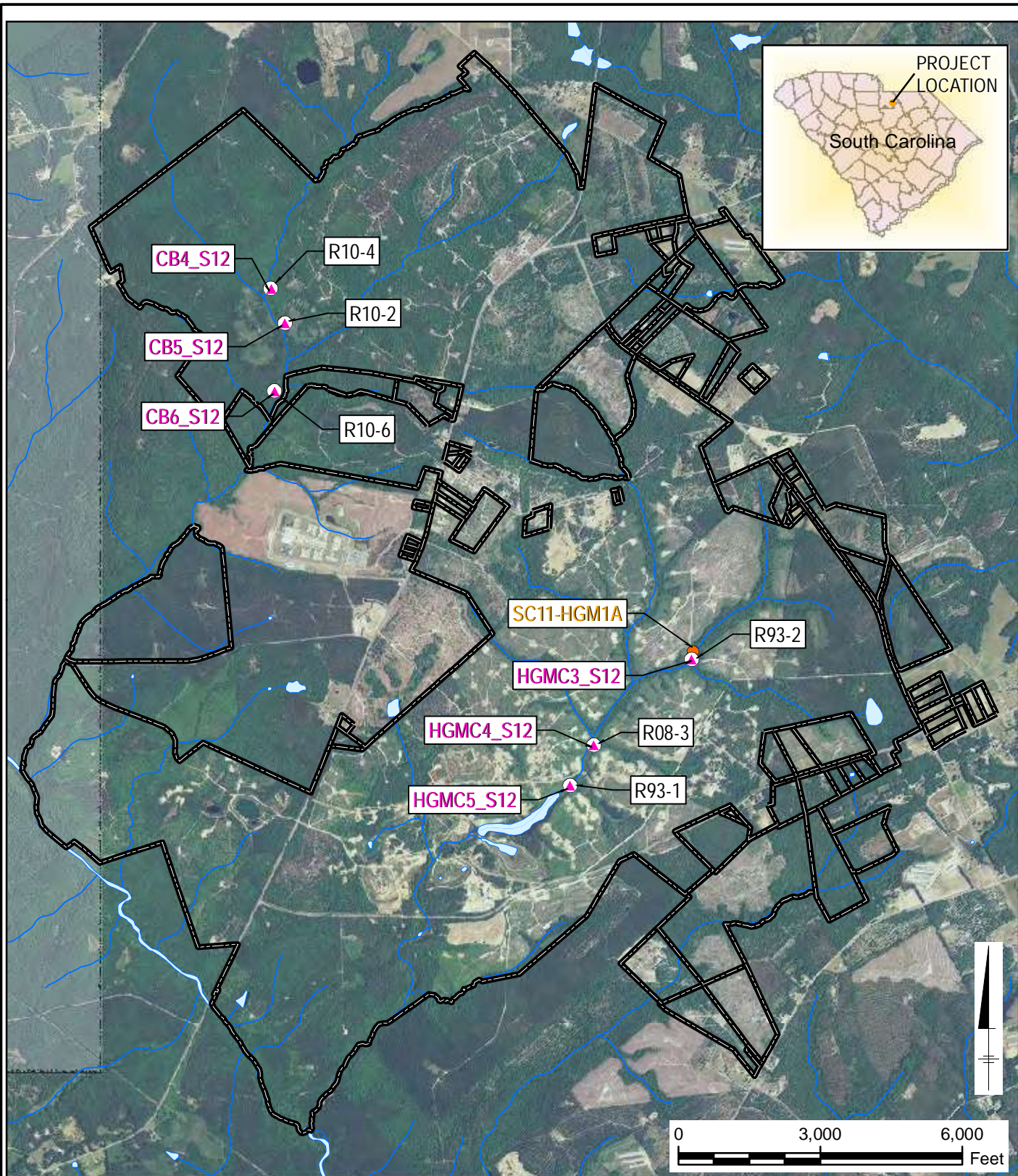
HAILE GOLD MINE, INC.

SPRING 2012 AQUATIC RESOURCE SURVEYS REPORT

MIGRATORY FISH SURVEY LOCATIONS



FIGURE
2-1



- Site Boundary
- ▲ Spring 2012 Survey Locations
- DNR Survey Locations
- Rohde Fish Survey Locations

CB = Camp Branch
HGMC = Haile Gold Mine Creek

Projection: UTM Zone 17, NAD 83
Orthophotography: NAIP 2011 1 Meter GSD

HAILE GOLD MINE, INC.

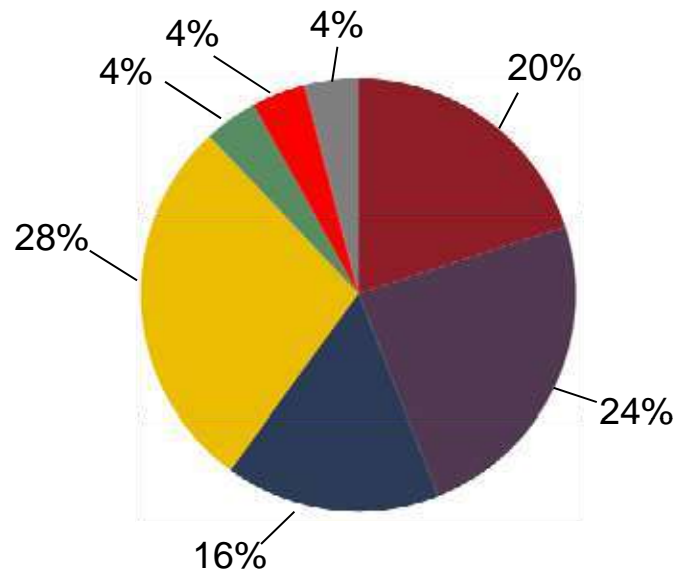
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SPRING 2012 HABITAT ASSESSMENT LOCATIONS

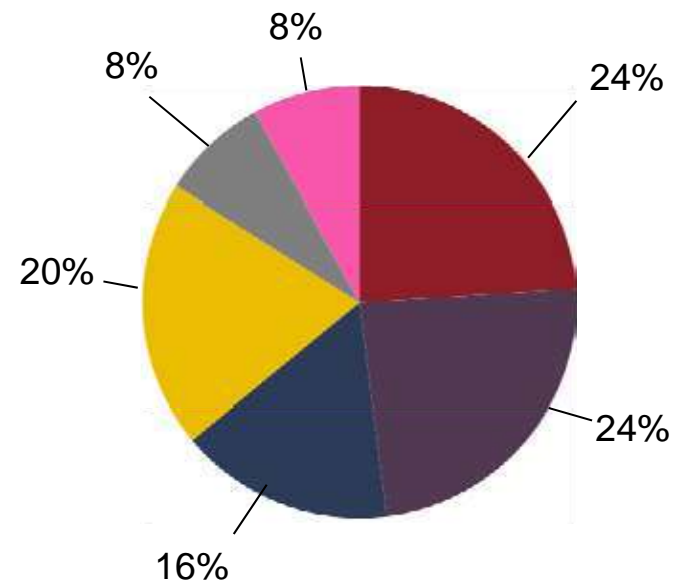


FIGURE
3-1

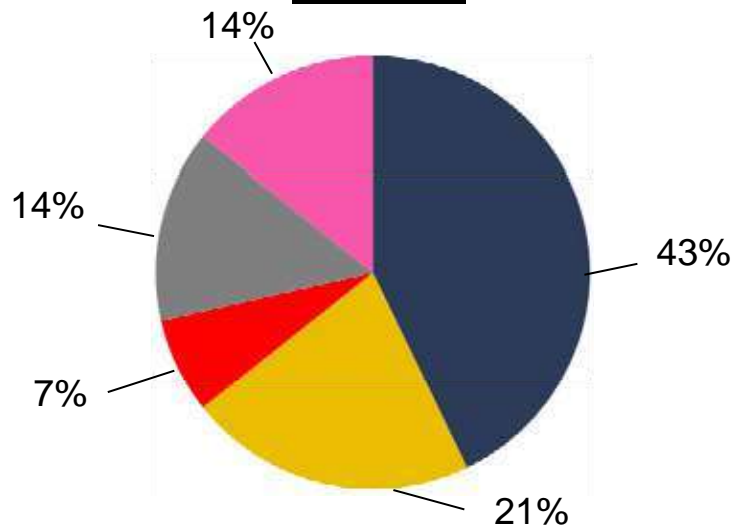
HGMC3



HGMC4



HGMC5



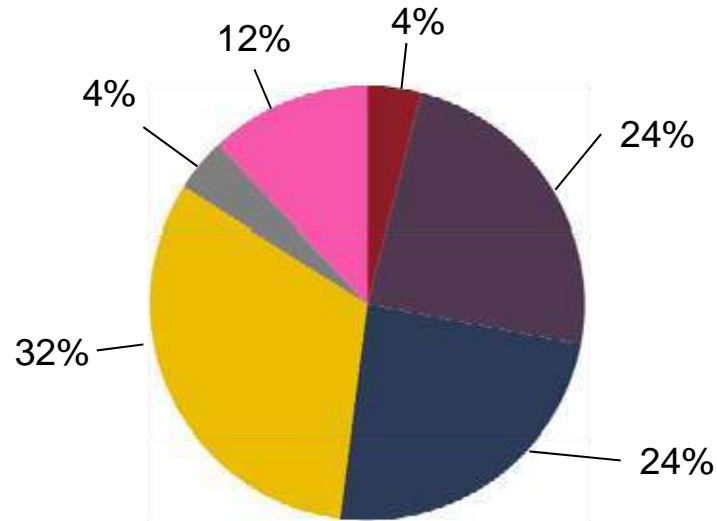
HAILE GOLD MINE, INC.
 SPRING 2012
 AQUATIC RESOURCE SURVEYS REPORT

SUBSTRATE COMPOSITION OF
 HAILE GOLD MINE CREEK REACHES

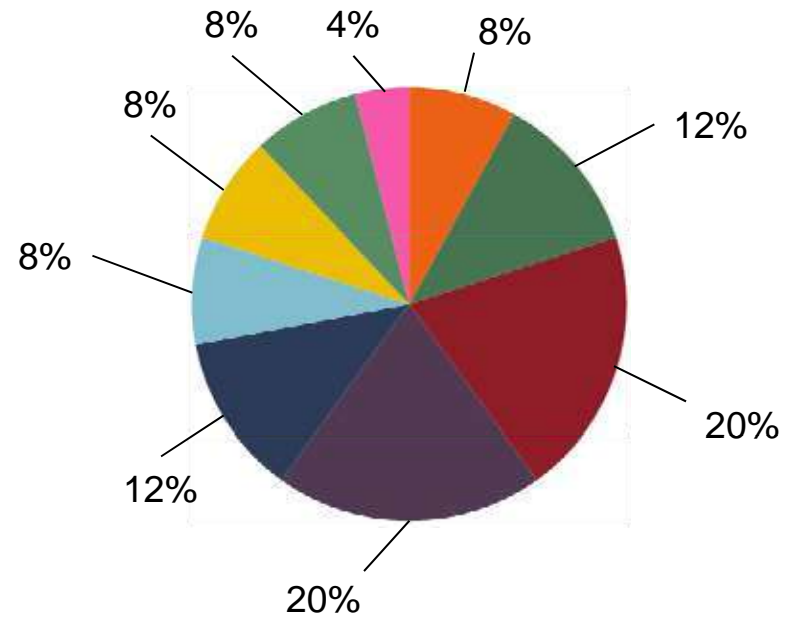


FIGURE
3-2

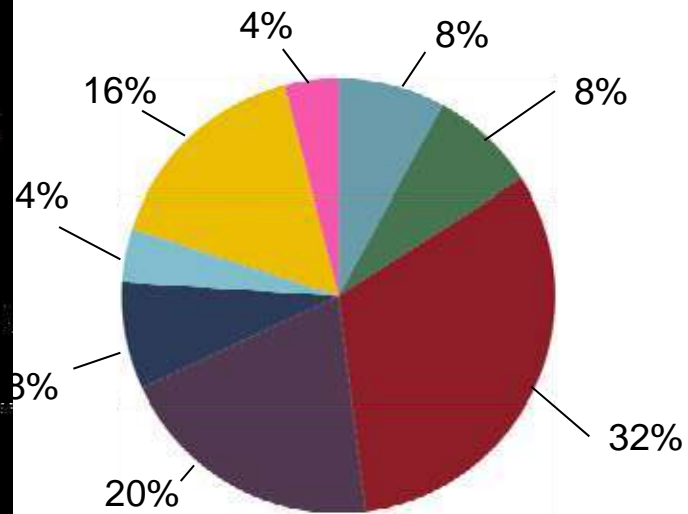
CB4



CB5



CB6

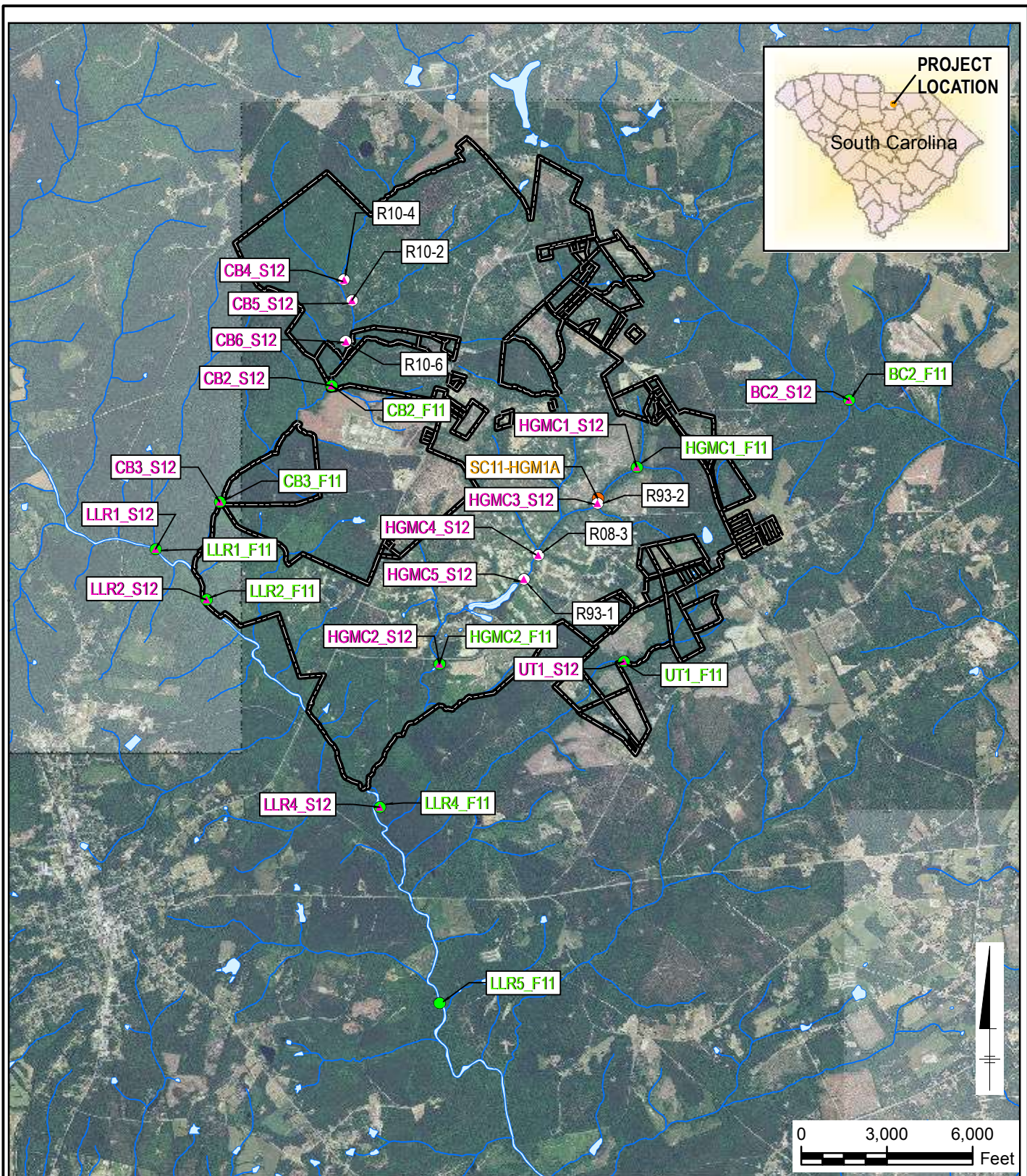


HAILE GOLD MINE, INC.
SPRING 2012
AQUATIC RESOURCE SURVEYS REPORT

SUBSTRATE COMPOSITION OF
CAMP BRANCH REACHES



FIGURE
3-3



- Site Boundary
- Spring 2012 Survey Locations
- Fall 2011 Survey Locations
- DNR Survey Locations
- Rohde Fish Survey Locations

Note: BC4_F11 not shown

BC = Buffalo Creek
CB = Camp Branch
HGMC = Haile Gold Mine Creek
LLR = Little Lynches River
UT = Unnamed Tributary

Projection: UTM Zone 17, NAD 83
Orthophotography: NAIP 2011 1 Meter GSD

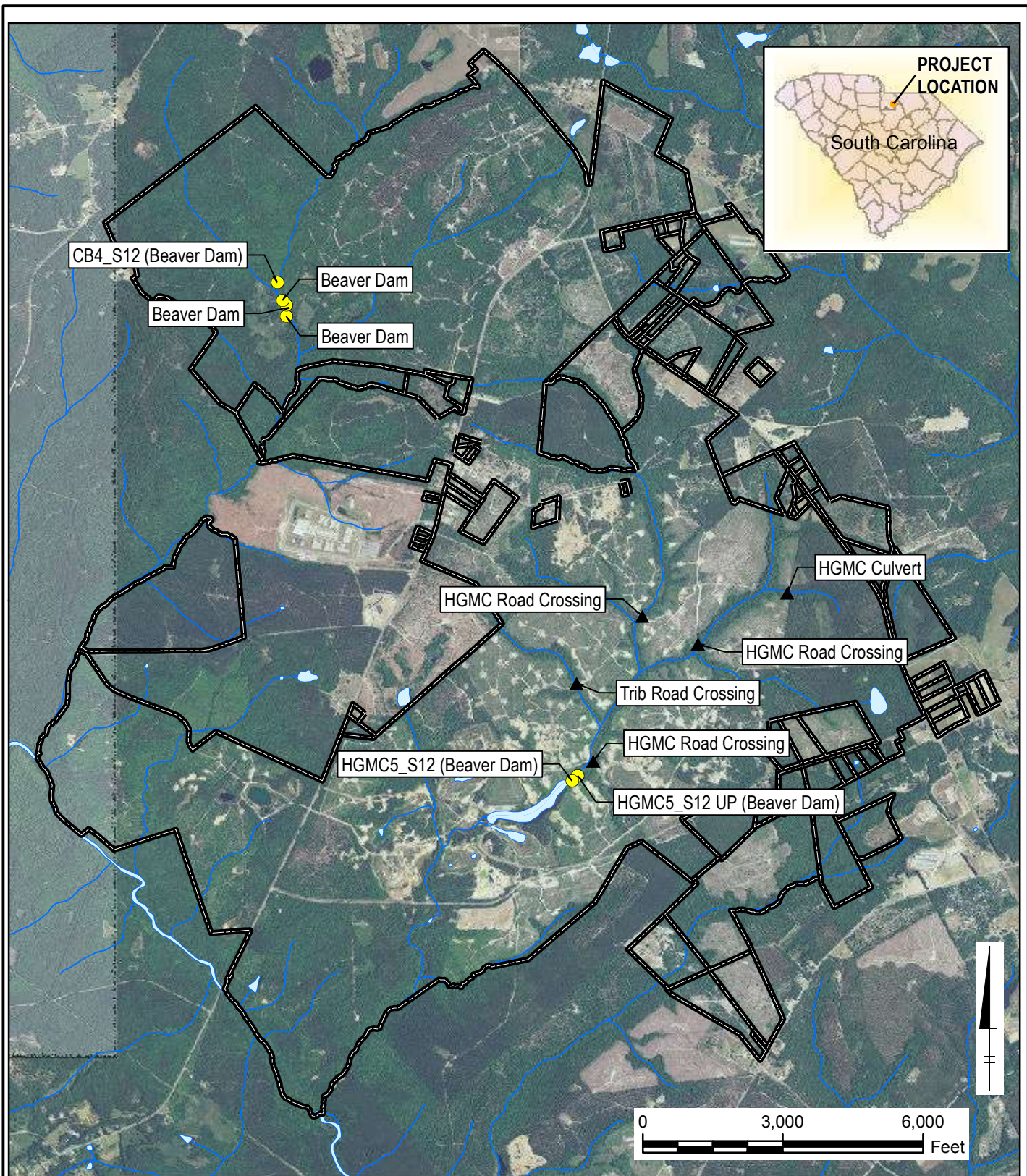
HAILE GOLD MINE, INC.

SPRING 2012 AQUATIC RESOURCE SURVEYS REPORT

RESIDENT FISH SURVEY LOCATIONS



FIGURE
4-1



- ▲ Man-made
- Natural
- Site Boundary

BC = Buffalo Creek
 CB = Camp Branch
 HGMC = Haile Gold Mine Creek
 LLR = Little Lynches River
 UT = Unnamed Tributary

Projection: UTM Zone 17, NAD 83
 Orthophotography: NAIP 2011 1 Meter GSD

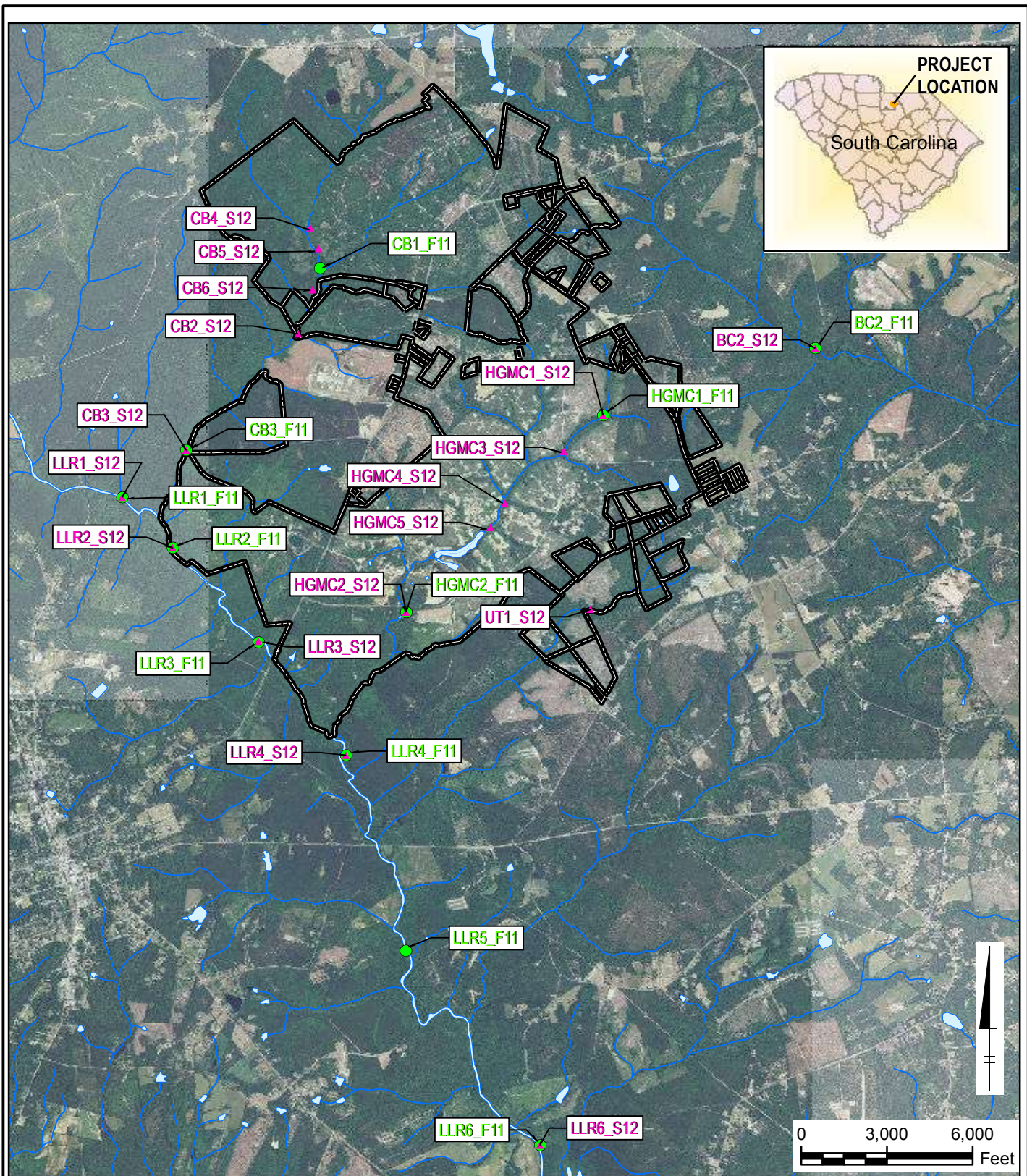
HAILE GOLD MINE, INC.

SPRING 2012 AQUATIC RESOURCE SURVEYS REPORT

IN-STREAM NATURAL AND MAN-MADE HABITAT FEATURES



FIGURE
4-2



- ▲ Spring 2012 Survey Locations
- Fall 2011 Survey Locations (Note: BC4_F11 is not shown.)

— Site Boundary

BC = Buffalo Creek
 CB = Camp Branch
 HGMC = Haile Gold Mine Creek
 LLR = Little Lynches River
 UT = Unnamed Tributary

Projection: UTM Zone 17, NAD 83
 Orthophotography: NAIP 2011 1 Meter GSD

HAILE GOLD MINE, INC.

SPRING 2012 AQUATIC RESOURCE SURVEYS REPORT

BENTHIC MACROINVERTEBRATE SURVEY LOCATIONS



FIGURE
5-1



Haile Gold Mine

Spring 2012 Aquatic
Resource Surveys Report

Appendix A

Spring 2012 Migratory Fish Survey Field Notes and Photographs

3/27/12 Migratory fish survey
730-8 crew collects gear (2) Hile air
and deploys to first location (most
upstream).

crew: MTF, Arcadis Alderman, Teku, Joseph,
Neil & Paul Albornes.

oversight: none.

weather: sunny, 60/45-60°

lot
34.5774980 56732 NAD83 upstream
34.57654 / 80.56596 downstream

830 crew performs H&S meeting, discusses
protocol & sets equipment.

9-11am crew sets 10 eel traps, 1
hoop net in reach. crew shocks
downstream to upstream using 2 backpack
units to cover the entire sample area.
1 American eel shocked from pool just
downstream of dam at upper end
of reach. crew photographs eel, takes
photo, (22cm) and releases it.
substrate was mostly silt with occasional
cobble.

water quality:

flow: 0.07 m/s pH: 7.92
Temp: 15.64°C conductivity: 0.073 mS/cm
turbidity: 9.8 NTU DO: 8.93 mg/L

11am crew departs location

1:00 - 2:40 pm
crew mobilizes to middle reach.
reach is rocky with gravel/cobble substrate.
water quality

flow: 0.34 m/s pH: 7.53
temp: 18.95°C conductivity: 0.070 mS/cm
turbidity: 16.5 NTU DO: 10.42 mg/L

Downstream

34.52788 / 80.53475 long
UPSTREAM 34.52938 / 80.53509

Crew electro fishes downstream to upstream for
one complete pass of the reach. No migratory
species observed. crew sets eelpot in
good habitat throughout the reach and departs.

Return to the River

3/27/12 cont'd.

Downstream Location 3:40pm

Flow 0.31 m/s Ph 6.77
Temp 17.73°C Conductivity 0.065 mS/cm
Turbidity 6.8 mV DO 8.36 mg/L

Crew mobilizes to downstream location, takes water quality, and sets eel pots. Crew then makes one pass of the active reach working downstream to upstream to shock the whole area.

GPS. Uad 83
downstream: 34.47947 / 80.50516
upstream: 34.47985 / 80.50603

This reach is deeper with more cobbles and woody debris. No minnow/fish observed during shocking. Mostly sand/soft substrates. Fish community was similar to other reaches in composition, but generally lower abundance.

3/28/12

730-8 crew mobilizes to H6M and packs equipment.

830 crew heads to H6M creek to shock one of three additional locations requested by Tennant Pappas & Peavy Hunter. crew sets up a ^{100m} reach upstream of the confluence with the little river and performs H & S meeting.

water quality @ H6M creek.

Flow 0.29 m/s Temp 13.95°C
turb 35.2 mV Ph 4.26
Cond 0.107 mS/cm DO 10.35 mg/L

GPS
downstream

34.56274 / 80.55145
upstream 34.56330 / 80.55094

No fish observed in shocking, several crayfish and frogs observed.

Rite in the Rain

9:05-crow moves to dam location (noostepan in lynches) and checks eelpots and vet.

In vet, 1 yellow belly turtle

In eelpots: most fan traps in dam (2+ foot) holes with muddy debris

Bluehead chub "

Redbreast sunfish 1

Cypinella chlorosticta 1

pirate perch 1

notopis luminisae 1

crow shocks entire reach from downstream to upstream and sees fewer fish than yesterday. No migratory species observed / collected

10:15-crow moves downstream to shock chump
Black creek per Johnny Pappas.

bps

downstream 34.57586 80.56448

upstream 34.57658 80.56486

crow finds champion branch (very small, shallow trib) and works upstream 100 yards from confluence with the little lynches.

3/28 cont'd

water quality in champion branch

flow: 0.05 m/s DO: 9.92 mg/l

Temp: 13.24°C pH: 6.24

Cond: 0.032 mS/cm turb: 5.5

stream is shallow and incised, several creek chubs, crayfish & frogs observed in deeper (6-12") pools.

No migratory species observed / collected.

12:00 crew moves to middle location on lower lynches. PCL traps produced (below). fish were scattered throughout creek pirate perch: 10 various traps

bluehead chub: "

Redbreast sunfish: "

platycephalus (flatbilled) "

crew shocks entire reach downstream to upstream. No migratory species observed / collected. 1 large (approx 25-30 lb) snapping turtle observed. Species / abundance of fish same as 3/27.

Return to the River

3/28 cont'd.

1230 crew sets hoopnet ditches and departs site at 1:15. No net set to completely block channel, fish must go through.

1:45 downstream reach little lynches crew heads to downstream reach. Little lynches and checks eel pots, sets hoop net. In the eel pots, 1 pirate perch and 1 pharyngopharyngus (flat bullhead collected).

crew shocks entire reach and extends upstream approx 30 meters from stop yesterday. crew collects 1 Silver American eel at upstream end of reach in blow down / root wad. crew photographs measures eel and releases it. 230 crew finishes setting hoop net & heads and departs

No net set in deep hole at upstream third of the reach with lead wings completely blocking off the channel. Fish would have to swim through the net to move upstream.

3/28/12

3:25 pm crew moves to camp black and heads downstream from ~~St. Bernard~~ ^{St. Bernard} towards confluence w/ Little Lynches. crew sets up ~~150m~~ ^{150m} reach and shocks upstream.

6 PM downstream

34.58670 80.56936

34.58769 80.56937 - upstream

Water Quality

temp 19.42 °C

pH 6.42

Flow 0.05 m/s

turb 46.5

Cond 0.033 mS/cm

D/D 9.30 m/s

No migratory fish species collected during shocking.

4 pm crew departs and heads back to HGM to break down.

Rite in the Rain

21/5/12

crew: same
weather: sunny, warm
overnight none.

8:00 crew performs H&S meeting at
trucks at upstream little (pools (down)
location. crew checks net and
bags. No organisms collected
in hoop net. in eel pots
2 pirate perch, 1 bluehead chub, 1 redbreast
sunfish.

8:20-8:45 crew moves down and checks
Champion branch. No migratory species
observed, few chubs and gray fish seen
but not collected.

8:45 crew checks little (pools reach
no migratory species observed. Abundant
diversity similar to previous days.

9:00-9:05 crew checks little goldmine creek,
no fish observed.

3/25 cont'd

9:45-10:00 crew moves to camp
Branch creek to check for
migratory species. No migratory species
observed, abundance of darters
comparable to previous day.

10:30-11:15 - crew checks middle reach of
little (pools. No migratory species observed
during shocking. 1 large (25-30 lb) snapping
turtle caught in hoop net. turtle
released alive and net reset. Note
net was set in a deep hole adjacent to
a downed log and with the birds
completely blocking off the creek. Any
target species moving upstream would have
to pass through the net.

eelpots were checked and re baited.
eelpots produced no migratory species (eels)
but did collect species below:

pirate perch
fosselated darter:
bluehead chub
Carpinella chlorisina:
redbreast:

After rain

3/29/12 cont'd

130-280m shoals downstream reach
of little Inches. No migratory
species (eel, steel, herring) observed.
One chubs hoop net and releases
2 "approx 16" spotted suckers from the
net. Net is reset. Note that
net is set in deeper hole approx
2/3 the way up the sample reach
and the leads completely block the
stream so any organisms moving
upstream would be forced into
the net.

One chubs eelpots, no eels
observed. 1 pirate perch caught and
released. (new rebait traps and
depots).

230-430 (new bins down gear @ H&M -

4/16/12 week 2 migratory fish survey.

weather: Sunny, hot (80°) overcast: wave

1240 - MAF arrives on-site and meets the

Alderman crew at the Haile mine ^(top of hill)

crew loads nets & el traps and (1st)

departs for the middle fish survey (Cass?)

reach as the land owner has requested

we be out of there before 10 am and

after 3 pm for turkey hunting.

130 - 215 crew sets 10 "bee" minnow

trap" style el traps and 3 of the

Japanese style traps John Alderman borrowed

from Duke power in the reach and

set the hoop net in the same location

as in the first week. water

level is low and clear compared to

first week.

215 - 41 pm crew moves to the downstream

location, sets the hoop net in the

same location, and sets 10 "minnow

trap" style el traps and 3 Japanese

style traps throughout the sample

reach.

4-530 pm crew sets hoop net

and 12 el traps (10 minnow trap, 2 Japanese

style) throughout the reach. Net is

4/16/12 cont'd

placed in the same location as in first

survey. traps are spread all the way from

the dam to the bottom of the reach.

water is lower and more clear than

during first survey. Visibility is

good (bottom can be seen even in the pool

downstream of the dam).

530 pm crew returns to the HGM

retrieves radio signs out, and charges

batteries for backpack shockers before

departing.

John Bowers (803) 475-3521

land owner for downstream

LL reach. He spoke with John

Alderman and granted access the

owner the land on both sides of

the creek and as such, owns the creek

itself (according to him, crew did not

verify S.C. water rights laws).

Rite in the Rain

4/17/88

fish surveys

8:00 crew meets at H.M. Steward & loads equipment, does H&S tailgate.

9 am - crew moves to mfs 3 (downstream 2.1 miles), does quick electrofishing & H&S refresher.

Water quality:

~ m4f

Temp 24.1 °F PH 7.35
 turbidity 2.0 TDS 0.00 mg/L
 * total nitrogen 0.00 DO 9.77 mg/L
 flow m/s 0.26 m/s
 * = possible water error.

Temp 17.8°C DO 8.73 mg/L
 cond 0.056 us/cm PH 6.87
 turb 15.7 NTU TDS 0.047 g/L
 flow 0.26 m/s

M4f & Joseph Alderman show entire reach from lower upstream to downstream. 1 large (14.34 inch) eel shocked from deep hole adjacent to hoop net set. eel was photo graphed, measured, and released.

fish surveys cont'd.

Tolu, Dell & Paul Alderman check eel traps. 3 *Potamorhine* (sp.) collected from the eel pots. 1 black bullhead collected and released from the hoop net.

1045 - crew departs mfs 3

1200 crew moves to middle section of H&P Lynces (mfs-2).

flow 0.34 m/s DO 10.56 mg/L
 Temp 18.16°C PH 7.02
 cond 0.069 us/cm TDS 0.052 g/L
 turb 7.4 NTU

Joseph Alderman and M4f shock complete reach from downstream to upstream and do not observe collect any.

migratory fish (eel, herring, shad, etc.) Dell, Tolu & Paul check the eel pots and rebait them. Eel collected in eel pots; 57 bluehead chub, 3 pike perch, 59 C. chlorostictus, 7 brownhead shiner, 1 *V. paterosomus*, 2 mottled madtom, 6 redear sunfish. *Rare in the rain.*

C/17 cont'd

1 slider (turtle) caught in hoop net
and 1 cottonmouth observed just next
to the net in log jam
130 crew departs.

145- crew mobilizes to MFS-1. crew
walks downstream to Champion creek
water quality is

Temp 21.05°C DO 10.12 mL/L
Flow 0.12 m/s PH 6.83
Cond 0.039 mS/cm TDS 0.028 g/L
Turb 10.0 NTU

MFS shows active reach, no fish observed
after first pool above confluence.
Water very low (less than 1" in most of
reach).

Crew moves back up to MFS-1. water quality
flow 0.18 m/s PH 7.16
Temp 19.17°C DO 9.65 mL/L
Cond. 0.083 mS/cm TDS 0.061 g/L
Turb. 3.8 NTU

Matt & Joseph show active reach working
downstream to upstream. No migratory
fish observed/collected during shocking.
Crew checks owl pots and collects.

N. Piarre 30, N. Altipia's 68, bluehead
chub 46, tessellated darter 2, pirate
perch 6, goldbreast sunfish 33, 1 green
sunfish, 58 C. colonistia
hoop net caught 1 turtle slider).
1 large cottonmouth seen just below
dam. traps are rebaited and crew
departs at 3:10.

330 crew moves to Camp branch
for migratory fish survey.

water quality

Flow 0.28 DO 9.53
Temp 14.30° PH 7.13
Cond 0.039 mS/cm turb ~~14.0~~ NTU
TDS 0.028 g/L

130 migratory fish observed during
shocking pass of active reach.

Return to Rain

cont'd

445: crew moves to HGMC

water quality

flow 0.27 m/s

ph 4.00

temp 21.16°C

DO 9.88 mL

load

0.161 kg/m turb 3.5 NTU

TDS 0.113 g/L

MTF makes 1 pass of entire reach with backpack net. No fish observed in entire reach, a few green frogs and crayfish

445-crew departs

4/18/12

weather: cloudy, overcast, rained right before sunrise
overcast: none

830 crew mobilizes to trail leading to creek (MFS 6) to search for migratory species. No fish observed (a few frogs and crayfish only).

915 crew moves to camp branch (MFS 4) area to search. No migratory species observed.

1000 crew moves to MFS (2) middle reach. Crew searches entire reach, no migratory fish observed. Crew checks traps, and collects:

Bluehead Chub - ☒ ☒ = 29

N. petersoni - ☒ = 3

C. chlorosticta - ☒ ☒ = 30

C. americana - ☒ = 1

C. obsoletus - ☒ = 1

Ranunculus - ☒ = 1

N. praeceps - ☒ = 1

E. olivaceus - ☒ = 1

N. chlorostictus - ☒ = 2

Rain in the rain

4/18 cont'd

No organisms observed (collected in the hoop net).

11:15 crew departs.

1220 crew arrives at the lower reach of the little Wyndes (MFS-3) to check traps, Net and shock for migratory fish. 2 eels (35cm and 51cm) shocked up, 1 from lower third off the reach, 1 from hole adjacent to hoop net.

Eels measured, photographed, and released. Eel traps produced 2 tailspot mudminnows and 1 flat bellhead. Nothing collected in the hoop net but a large animal (possibly a porbeagle?) had torn a large hole in the long of the net and escaped. Net is repaired and reset. Traps are baited and reset and crew departs at 1230.

130

Some rain (shoalstone flows in and crew takes shelter. 230 ~~4~~ 215 the thunder subsides, crew waits 30 minutes with no new thunder heard and mobilizes to MFS-1.

230-300 crew Skolers MFS-1 (upper reach) of little Wyndes. 1 eel collected from near the base of the dam (25.7cm). eel is photographed, measured, and released. crew checks eel traps and collects and releases the following: N. Pinnate, N. 44 pinis 5, Noturus leptocephalus 141, tessellated darter 3, Pirate perch, red bass 26, a cyprinella coloradensis 2. Nothing was observed/collected in the net.

3-330 crew moved downstream to Champion MFS-5 and shocked. No migratory fish observed, only a few chubs in the first pool upstream of confluence. Rest of reach was very shallow >1" 335 crew returns to HGM to charge batteries, unload equipment.

Return in 250s Rain

4/19/12 Migratory fish survey

Crew MFR, Joseph Alderman, & Paul Alderman (AES, Ind)
Weather: Cloudy, overcast, cool, rained yesterday afternoon and during the night.

8:30 crew meets at H&M, loads batteries and departs to H&M Creek. (MFS-6)
Crew shocks entire reach and does not observe any fish (few frogs & crayfish).

9:15-9:30 Crew heads to camp branch (MFS-4) and shocks entire reach. No migratory fish observed.

9:30- crew shocks MFS-5 (upper reach at lower Lynch's) NO fish observed.

10:05 - downstream from dam (MFS-1)

WQ & Flow: DO - 9.22 mg/l;
pH - 7.9; ~~temp~~ - 16.6°C; ~~temp~~ - 8.6 m/s;
Flow - 0.18 m/s

MF & SA shock entire reach, no eels or other migratory fish observed.

4/19/12 cont'd

Crew checks eel traps and collects and releases the following: *Natipinnis* cf. *shufeldti*, *Chubs* 23, tessellated darter?, Pirate perch?, gambusia, 9 red breast sunfish.

NO organisms were collected in the hoop net. As this is the third trap right, traps and hoop net are pulled.
11-crew departs.

12:15 Crew moves to middle reach (MFS-2)
temp 16.28°C DO 10.88
TDS 0.050 mg/L PH 7.09
flow 0.40 m/s turb 3.1 NTU
COND 0.063 mS/cm

MF & SA shock entire reach from downstream to upstream. No eels or other migratory fish observed.

Crew checks eel traps and collects/clears: pirate perch!, bluehead chub, *Chlorostichus* cf. 7, red breast sunfish!, married mudminnow!,
No organisms collected in hoop net.
all traps and net pulled.

11:55 crew departs

Red in the dam

4/19/12 cont'd

1/5 crew m.b. 12:15 to MFS-3 Clower reach old
little (yuccas).

flow 0.38 m/s
Temp 16.93°C
cond 0.056 μ S/cm
TDS 0.043 g/L
pH 6.75
DO 9.11 mg/L
turbidity 9.62 NTU

MP & JA shock entire reach moving downstream
to upstream, 1 medium sized oel
observed but not collected,
(disappeared into log jam in deep
hole near to wet). It appeared to be
approx 30cm. No other migratory
fish observed.

Crew pulls eel traps (no fish collected,
only a few crayfish) and hoop
net (1 spotted sucker collected and
released) and departs from test
at 230.

Rite in the Rain



1

Electrofishing in reach MFS6 in Camp Branch



2

Fyke net in reach MFS3 in the Little Lynches River

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LANCASTER COUNTY, SC
SPRING 2012 AQUATIC RESOURCE SURVEYS REPORT

**SPRING 2012 MIGRATORY FISH SURVEY
PHOTOGRAPHS**



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Gee® Eel Trap in reach MFS2 in the Little Lynches River



4

Reach MFS1 in the Little Lynches River looking upstream from downstream

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**SPRING 2012 MIGRATORY FISH SURVEY
PHOTOGRAPHS**



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Pooled water downstream of the dam in reach MFS1 in the Little Lynches River



6

American eel (*Anguilla rostrata*) caught during the first survey event in reach MFS1 in the Little Lynches River

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SPRING 2012 MIGRATORY FISH SURVEY PHOTOGRAPHS



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American eel (*Anguilla rostrata*) caught during the second survey event in reach MFS1 in the Little Lynches River



8

Reach MFS2 in the Little Lynches River looking downstream from upstream

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SPRING 2012 MIGRATORY FISH SURVEY PHOTOGRAPHS



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Fyke net set in large pool in the middle of reach MFS2 in the Little Lynches River



10

Reach MFS3 in the Little Lynches River looking upstream from the middle of the reach

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**SPRING 2012 MIGRATORY FISH SURVEY
PHOTOGRAPHS**



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Reach MFS3 in the Little Lynches River looking downstream from the middle of the reach



12

American eel (*Anguilla rostrata*) caught during the first survey event in reach MFS3 in the Little Lynches River

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SPRING 2012 MIGRATORY FISH SURVEY
PHOTOGRAPHS



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First American eel (*Anguilla rostrata*) caught during the second survey event in reach MFS3 in the Little Lynches River



14

Second American eel (*Anguilla rostrata*) caught during the second survey event in reach MFS3 in the Little Lynches River

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SPRING 2012 MIGRATORY FISH SURVEY PHOTOGRAPHS



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Third American eel (*Anguilla rostrata*) caught during the second survey event in reach MFS3 in the Little Lynches River



16

Reach MFS4 in Haile Gold Mine Creek looking upstream from the middle of the reach

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SPRING 2012 MIGRATORY FISH SURVEY PHOTOGRAPHS



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Reach MFS4 in Haile Gold Mine Creek looking downstream from upstream



18

Reach MFS5 in Champion Branch looking upstream from the middle of the reach

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SPRING 2012 MIGRATORY FISH SURVEY
PHOTOGRAPHS

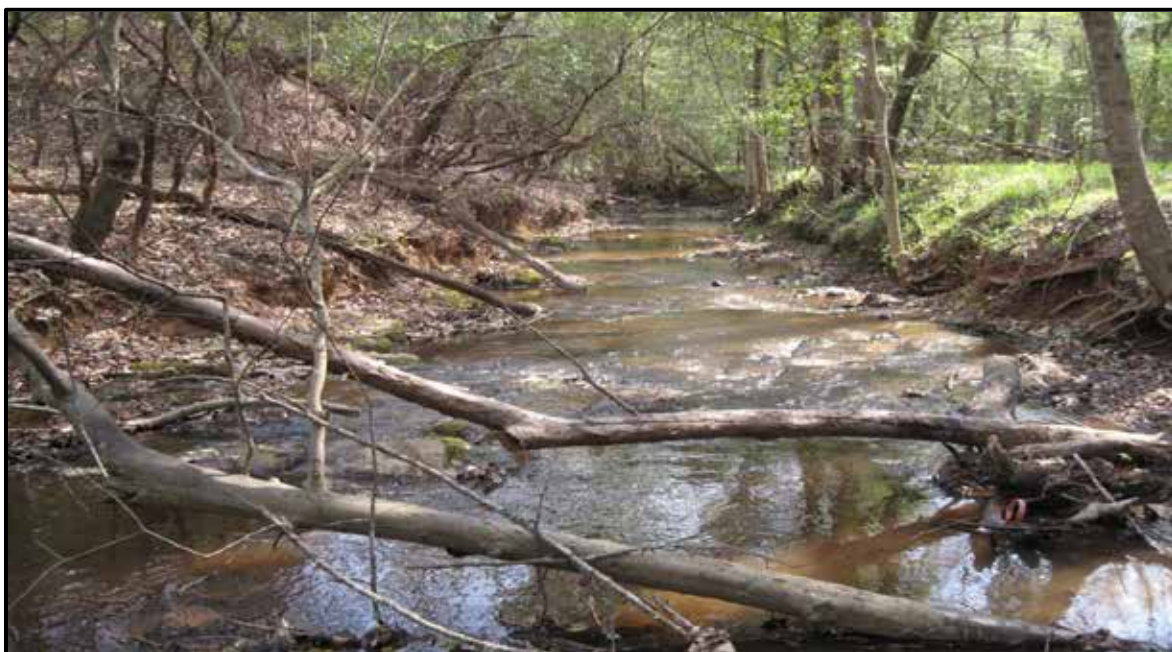


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Reach MFS5 in Champion Branch looking upstream from downstream



20

Reach MFS6 in Camp Branch looking downstream from the middle of the reach

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SPRING 2012 MIGRATORY FISH SURVEY
PHOTOGRAPHS




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Reach MFS6 in Camp Branch looking upstream from downstream

<p>HAILE GOLD MINE, INC. LANCASTER COUNTY, SC SPRING 2012 AQUATIC RESOURCE SURVEYS REPORT</p>	
<p>SPRING 2012 MIGRATORY FISH SURVEY PHOTOGRAPHS</p>	
	<p>Appendix A</p>



Haile Gold Mine

Spring 2012 Aquatic
Resource Surveys Report

Appendix B

Spring 2012 Aquatic Habitat Assessment Field Notes and Photographs

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES
STREAM ASSESSMENT DATA SHEET



DATE: 4/5/2012 SITE NUMBER: H6MC-3

HABITAT CHARACTERIZATION	Depth (m) ft		Velocity (m/s)		Substrate: inorganic (mm) or organic category		Width (m) ft		Pool/Riffle/Run Velocity (m/s)		Substrate: inorganic (mm) or organic category	
	1	0.4	0.21		2		26	4.8	Run			
	2	0.4	0.25		CPOM		27		Run		*	fine woody debris
	3	0.2	0.23		sand		28		Run			
	4	0.65	0.21		CPOM		29		Run		stable	3 trunks - 8"x2', 4"x1', 4"x2'
	5	0.6	0.16		CPOM		30	4.2	sh pool			
	6	0.2	0.30		LWD		31		Run		stable	10"x3' - root wad
	7	0.1	0.17		7		32		Run		LWD	4"x6', 2"x6'
	8	0.3	0.39		sand		33		Run		LWD(s)	Root wad (stable)
	9	0.55	0.2		10		34		sh pool (7"x3')		LWD	(2) 3"x4', 3"x2', 2"x4'
	10	0.2	0.32		FWD		35	4.1	Run			
	11	0.45	0.18		FPOM		36		sh pool			
	12	0.3	0.24		CPOM		37		run			
	13	0.25	0.19		silt		38		run		LWD	-(7'x11') stable
	14	0.3	0.25		3		39		run		LWD	-10"x5', 8"x7', 2"x3'
	15	0.05	0.21		1		40	3.5	run		RW (stable)	* by sand bar
	16	0.3	0.37		CPOM		41		run		LWD	-10"x3.5'
	17	0.3	0.16		silt		42		sh pool		LWD	-14"x3.5'
	18	0.4	0.13		CPOM		43		sh pool (stable)		LWD	-2"x3', 3"x4', 2"x5'
	19	0.2	0.37		sand		44		run (stable)		LWD (3)	-2"x7', 4"x2', 3"x5'
	20	0.1	0.14		sand		45	4.7	run (stable)		LWD	-3"x7'
	21	0.2	0.33		silt		46		run			
	22	0.3	0.11		4		47		run		LWD (s)	-2"x3' (x4) 4"x2'
	23	0.45	0.1		CPOM		48		sh pool			
	24	0.65	0.13		sand		49		sh pool			
	25	1.1	0.23		silt		50	5.9	sh pool		LWD	-10"x5', 10"x3' (stable)

RW (stable) 2'x3'

HABITAT NOTES	Reach is based on historic Rohde 93-2 location and upstream end of reach ends at road culvert.	
	Stable LWD is found throughout reach	
	A few sand bars exposed. No SAV observed.	

Mixed canopy of pines, poplar, gum,
Understory holly, briar, ferns

**PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)**

STREAM NAME <u>HGMC-3</u>	LOCATION <u>Kershaw, SC</u>	
STATION # _____ RIVERMILE _____	STREAM CLASS _____	
LAT _____ LONG _____	RIVER BASIN <u>Little Lyncnes</u>	
STORET # _____	AGENCY _____	
INVESTIGATORS <u>DJB, MHE, EV, JCV</u>		
FORM COMPLETED BY <u>DJB</u>	DATE <u>4/5/12</u> TIME <u>3:15</u> AM <input checked="" type="radio"/> PM <input type="radio"/>	REASON FOR SURVEY <u>Habitat EIS</u>

WEATHER CONDITIONS	<p>Now</p> <p><input type="checkbox"/> storm (heavy rain)</p> <p><input type="checkbox"/> rain (steady rain)</p> <p><input checked="" type="checkbox"/> 70% showers (intermittent)</p> <p><input type="checkbox"/> %cloud cover</p> <p><input type="checkbox"/> clear/sunny</p>	<p>Past 24 hours</p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input checked="" type="checkbox"/> %</p>	<p>Has there been a heavy rain in the last 7 days?</p> <p><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <u>evening of 4/3/12 but did not last long or raise stream levels the next day</u></p> <p>Air Temperature _____ °C</p> <p>Other _____</p>
	<p>SITE LOCATION/MAP</p> <p>Draw a map of the site and indicate the areas sampled (or attach a photograph)</p> <p><u>See photos</u></p>		
STREAM CHARACTERIZATION	<p>Stream Subsystem <input checked="" type="checkbox"/> Perennial <input type="checkbox"/> Intermittent <input type="checkbox"/> Tidal</p> <p>Stream Type <input type="checkbox"/> Coldwater <input checked="" type="checkbox"/> Warmwater</p> <p>Stream Origin <input type="checkbox"/> Glacial <input checked="" type="checkbox"/> Spring-fed <input type="checkbox"/> Non-glacial montane <input type="checkbox"/> Mixture of origins <input type="checkbox"/> Swamp and bog <input type="checkbox"/> Other _____</p> <p>Catchment Area _____ km²</p>		

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(BACK)

WATERSHED FEATURES	Predominant Surrounding Landuse <input checked="" type="checkbox"/> Forest <input type="checkbox"/> Commercial <input type="checkbox"/> Field/Pasture <input type="checkbox"/> Industrial <input type="checkbox"/> Agricultural <input type="checkbox"/> Other <u>clear cuts, well pads/timber harvest</u> <input type="checkbox"/> Residential		Local Watershed NPS Pollution <input checked="" type="checkbox"/> No evidence <input type="checkbox"/> Some potential sources <input type="checkbox"/> Obvious sources														
			Local Watershed Erosion <input checked="" type="checkbox"/> None <input type="checkbox"/> Moderate <input type="checkbox"/> Heavy														
RIPARIAN VEGETATION (18 meter buffer)	Indicate the dominant type and record the dominant species present <input checked="" type="checkbox"/> Trees <input type="checkbox"/> Shrubs <input type="checkbox"/> Grasses <input type="checkbox"/> Herbaceous dominant species present <u>All present: tulip poplar, sweet gum, holly, pine</u>																
INSTREAM FEATURES <u>See S.C. data sheet</u>	<table border="0"> <tr> <td>Estimated Reach Length <u>100</u> m</td> <td>Canopy Cover <input type="checkbox"/> Partly open <input type="checkbox"/> Partly shaded <input checked="" type="checkbox"/> Shaded</td> </tr> <tr> <td>Estimated Stream Width _____ m</td> <td>High Water Mark <u>NA</u> m</td> </tr> <tr> <td>Sampling Reach Area _____ m²</td> <td>Proportion of Reach Represented by Stream Morphology Types</td> </tr> <tr> <td>Area in km² (m²x1000) _____ km²</td> <td><input type="checkbox"/> Riffle _____ % <input checked="" type="checkbox"/> Run <u>60</u> %</td> </tr> <tr> <td>Estimated Stream Depth _____ m</td> <td><input checked="" type="checkbox"/> Pool <u>40</u> %</td> </tr> <tr> <td>Surface Velocity _____ m/sec</td> <td>Channelized <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</td> </tr> <tr> <td>(at thalweg)</td> <td>Dam Present <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</td> </tr> </table>			Estimated Reach Length <u>100</u> m	Canopy Cover <input type="checkbox"/> Partly open <input type="checkbox"/> Partly shaded <input checked="" type="checkbox"/> Shaded	Estimated Stream Width _____ m	High Water Mark <u>NA</u> m	Sampling Reach Area _____ m ²	Proportion of Reach Represented by Stream Morphology Types	Area in km ² (m ² x1000) _____ km ²	<input type="checkbox"/> Riffle _____ % <input checked="" type="checkbox"/> Run <u>60</u> %	Estimated Stream Depth _____ m	<input checked="" type="checkbox"/> Pool <u>40</u> %	Surface Velocity _____ m/sec	Channelized <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	(at thalweg)	Dam Present <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Estimated Reach Length <u>100</u> m	Canopy Cover <input type="checkbox"/> Partly open <input type="checkbox"/> Partly shaded <input checked="" type="checkbox"/> Shaded																
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LARGE WOODY DEBRIS	LWD _____ m ² Density of LWD _____ m ² /km ² (LWD/ reach area) <u>See S.C. data sheet</u>																
AQUATIC VEGETATION	Indicate the dominant type and record the dominant species present <input type="checkbox"/> Rooted emergent <input type="checkbox"/> Rooted submergent <input type="checkbox"/> Rooted floating <input type="checkbox"/> Free floating <input type="checkbox"/> Floating Algae <input type="checkbox"/> Attached Algae dominant species present <u>NONE</u> Portion of the reach with aquatic vegetation <u>0</u> %																
WATER QUALITY	<table border="0"> <tr> <td>Temperature <u>18.43</u> °C</td> <td>Water Odors <input checked="" type="checkbox"/> Normal/None <input type="checkbox"/> Sewage <input type="checkbox"/> Petroleum <input type="checkbox"/> Chemical <input type="checkbox"/> Fishy <input type="checkbox"/> Other _____</td> </tr> <tr> <td>Specific Conductance <u>0.028</u> mS/cm</td> <td>Water Surface Oils <input type="checkbox"/> Stick <input type="checkbox"/> Sheen <input type="checkbox"/> Globs <input type="checkbox"/> Flecks <input checked="" type="checkbox"/> None <input type="checkbox"/> Other _____</td> </tr> <tr> <td>Dissolved Oxygen <u>8.29</u> mg/L</td> <td>Turbidity (if not measured) <input type="checkbox"/> Clear <input type="checkbox"/> Slightly turbid <input type="checkbox"/> Turbid <input type="checkbox"/> Opaque <input checked="" type="checkbox"/> Stained <input type="checkbox"/> Other _____</td> </tr> <tr> <td>pH <u>3.78</u></td> <td></td> </tr> <tr> <td>Turbidity _____</td> <td></td> </tr> <tr> <td>WQ Instrument Used _____</td> <td></td> </tr> <tr> <td><u>TDS 0.018</u> g/L</td> <td></td> </tr> </table>			Temperature <u>18.43</u> °C	Water Odors <input checked="" type="checkbox"/> Normal/None <input type="checkbox"/> Sewage <input type="checkbox"/> Petroleum <input type="checkbox"/> Chemical <input type="checkbox"/> Fishy <input type="checkbox"/> Other _____	Specific Conductance <u>0.028</u> mS/cm	Water Surface Oils <input type="checkbox"/> Stick <input type="checkbox"/> Sheen <input type="checkbox"/> Globs <input type="checkbox"/> Flecks <input checked="" type="checkbox"/> None <input type="checkbox"/> Other _____	Dissolved Oxygen <u>8.29</u> mg/L	Turbidity (if not measured) <input type="checkbox"/> Clear <input type="checkbox"/> Slightly turbid <input type="checkbox"/> Turbid <input type="checkbox"/> Opaque <input checked="" type="checkbox"/> Stained <input type="checkbox"/> Other _____	pH <u>3.78</u>		Turbidity _____		WQ Instrument Used _____		<u>TDS 0.018</u> g/L	
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red maple, giant core grass, ferns, rhododendron, grasses

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	Diameter	% Composition in Sampling Reach	Substrate Type	Characteristic	% Composition in Sampling Area
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	50
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	15
Gravel	2-64 mm (0.1"-2.5")	10			
Sand	0.06-2mm (gritty)	65	Marl	grey, shell fragments	
Silt	0.004-0.06 mm	15			
Clay	< 0.004 mm (slick)				

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME <u>HGMC-3</u>	LOCATION <u>Kershaw, SC</u>	
STATION # _____ RIVERMILE _____	STREAM CLASS _____	
LAT <u>See below</u> LONG _____	RIVER BASIN <u>Little Lynchies</u>	
STORET # _____	AGENCY _____	
INVESTIGATORS <u>DJB, MIF, EU, JCV</u>		
FORM COMPLETED BY _____	DATE <u>7/5/12</u> TIME <u>5:15</u> AM <input type="radio"/> PM <input checked="" type="radio"/>	REASON FOR SURVEY <u>Haile EIS</u>

Downstream ^N34.58884 W80.52544 Upstream ^N34.58947 W80.52463 NAD83

	Habitat Parameter	Condition Category			
		Optimal	Suboptimal	Marginal	Poor
	1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	SCORE	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
	2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
	SCORE	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
	3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	(5) 4 3 2 1 0
	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	SCORE	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	SCORE	20 19 18 17 16	15 14 13 (12) 11	10 9 8 7 6	5 4 3 2 1 0

- L. W. in oblique
7/6 cross section =
large
Deep > 1m

but small stream naturally

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.	
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.	
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.	
SCORE ____ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ____ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.	
SCORE ____ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ____ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone) Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.	
SCORE ____ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ____ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score _____

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES
STREAM ASSESSMENT DATA SHEET



DATE: 4/5/12

SITE NUMBER: H9MC-4

HABITAT CHARACTERIZATION					Pool/Riffle LWD (m)	
	Depth (m) ft	Velocity (m/s)	Substrate: inorganic(mm) or organic category	Width Depth (m) ft	Run Velocity (m/s)	Substrate: inorganic(mm) or organic category
1	1.05	0.22	3	26	6.8	RUN
2	1.3	0.19	sand	27	—	RUN
3	1.95	0.19	CPOM	28	—	RUN
4	0.49	0.32	AV	29	—	RUN
5	2.05	0.15	silt	30	6.2	RUN
6	0.65	0.27	sand	31	—	RUN
7	1.28	0.21	silt	32	—	RUN
8	1.38	0.25	CPOM	33	—	RUN
9	1.3	0.11	silt	34	—	RUN
10	0.85	0.16	AV	35	4.7	RUN
11	1.0	0.08	silt	36	—	RUN
12	1.14	0.21	sand	37	—	RUN
13	0.55	0.22	sand	38	—	RUN
14	0.8	0.17	2	39	—	RUN
15	0.65	0.23	CPOM	40	5.3	RUN
16	0.50	0.15	FWD	41	—	RUN
17	0.55	0.19	6	42	—	RUN
18	0.45	0.26	CPOM	43	—	RUN
19	0.4	0.45	2	44	—	RUN
20	1.30	0.15	sand	45	6.7	RUN
21	1.1	0.17	3	46	—	RUN
22	0.85	0.20	FWD	47	—	RUN
23	0.7	0.15	CPOM	48	—	RUN
24	0.3	0.31	6	49	—	RUN
25	0.3	0.21	sand	50	6.8	RUN

HABITAT NOTES	— No riffles or pools; incised channel that is all run and somewhat uniform depth and width	
	— 2 species AV (see photos) and filamentous algae	
	— Mix of young trees but mostly shrubs/vines	

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME <u>HGMC-4</u>		LOCATION <u>Kershaw, SC</u>	
STATION # _____ RIVERMILE _____		STREAM CLASS _____	
LAT _____ LONG _____		RIVER BASIN <u>Little Lynches</u>	
STORET # _____		AGENCY _____	
INVESTIGATORS <u>DJB, MHF, EV</u>			
FORM COMPLETED BY <u>DJB</u>		DATE <u>4/5/12</u> TIME <u>11:00</u> AM (PM) <input checked="" type="checkbox"/>	REASON FOR SURVEY <u>Habitat EIS</u>

WEATHER CONDITIONS	<p>Now</p> <p><input type="checkbox"/> storm (heavy rain)</p> <p><input type="checkbox"/> rain (steady rain)</p> <p><input checked="" type="checkbox"/> 80% showers (intermittent)</p> <p><input type="checkbox"/> %cloud cover</p> <p><input type="checkbox"/> clear/sunny</p>	<p>Past 24 hours</p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p>	<p>Has there been a heavy rain in the last 7 days?</p> <p><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No events of 4/3/12 but</p> <p>Air Temperature <u>70</u> °F did not last long</p> <p>Other _____ or raise stream levels the next day</p>
	<p>SITE LOCATION/MAP</p> <p>Draw a map of the site and indicate the areas sampled (or attach a photograph)</p> <p><u>See Photos</u></p>		
STREAM CHARACTERIZATION	<p>Stream Subsystem</p> <p><input checked="" type="checkbox"/> Perennial <input type="checkbox"/> Intermittent <input type="checkbox"/> Tidal</p> <p>Stream Origin</p> <p><input type="checkbox"/> Glacial <input checked="" type="checkbox"/> Spring-fed</p> <p><input type="checkbox"/> Non-glacial montane <input type="checkbox"/> Mixture of origins</p> <p><input type="checkbox"/> Swamp and bog <input type="checkbox"/> Other _____</p> <p>Stream Type</p> <p><input type="checkbox"/> Coldwater <input checked="" type="checkbox"/> Warmwater</p> <p>Catchment Area _____ km²</p>		

**PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(BACK)**

WATERSHED FEATURES	Predominant Surrounding Landuse <input checked="" type="checkbox"/> Forest <input type="checkbox"/> Commercial <input type="checkbox"/> Field/Pasture <input type="checkbox"/> Industrial <input type="checkbox"/> Agricultural <input checked="" type="checkbox"/> Other <u>clear cuts;</u> <input type="checkbox"/> Residential <u>wellpads; pine timber harvest</u>		Local Watershed NPS Pollution <input checked="" type="checkbox"/> No evidence <input type="checkbox"/> Some potential sources <input type="checkbox"/> Obvious sources Local Watershed Erosion <input checked="" type="checkbox"/> None <input type="checkbox"/> Moderate <input type="checkbox"/> Heavy <u>but many clear cuts nearby</u>
RIPARIAN VEGETATION (18 meter buffer)	Indicate the dominant type and record the dominant species present <input type="checkbox"/> Trees <input checked="" type="checkbox"/> Shrubs <input checked="" type="checkbox"/> Grasses <input type="checkbox"/> Herbaceous dominant species present <u>Mix of all 4 present; red maple, black cherry, giant cane grass,</u>		
INSTREAM FEATURES <u>See S.C. data sheet</u>	Estimated Reach Length <u>100</u> m Estimated Stream Width _____ m Sampling Reach Area _____ m ² Area in km² (m²x1000) _____ km ² Estimated Stream Depth _____ m Surface Velocity _____ m/sec (at thalweg) Canopy Cover <input type="checkbox"/> Partly open <input checked="" type="checkbox"/> Partly shaded <input type="checkbox"/> Shaded High Water Mark <u>NA</u> m Proportion of Reach Represented by Stream Morphology Types <input type="checkbox"/> Riffle _____ % <input checked="" type="checkbox"/> Run <u>100</u> % <input type="checkbox"/> Pool _____ % Channelized <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Dam Present <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
LARGE WOODY DEBRIS	LWD _____ m ² Density of LWD _____ m ² /km ² (LWD/ reach area) <u>See S.C. data sheet</u>		
AQUATIC VEGETATION	Indicate the dominant type and record the dominant species present <input checked="" type="checkbox"/> Rooted emergent <input type="checkbox"/> Rooted submergent <input type="checkbox"/> Rooted floating <input type="checkbox"/> Free floating <input type="checkbox"/> Floating Algae <input checked="" type="checkbox"/> Attached Algae dominant species present <u>2 AV species and filamentous algae (see photos)</u> Portion of the reach with aquatic vegetation <u>30</u> %		
WATER QUALITY	Temperature <u>18.50</u> °C Specific Conductance <u>0.019</u> mS/cm Dissolved Oxygen <u>9.66</u> mg/L pH <u>4.15</u> Turbidity <u>6.6</u> NTU WQ Instrument Used <u>Same as R10-2</u> TDS <u>0.014</u> g/L Water Odors <input checked="" type="checkbox"/> Normal/None <input type="checkbox"/> Sewage <input type="checkbox"/> Petroleum <input type="checkbox"/> Chemical <input type="checkbox"/> Fishy <input type="checkbox"/> Other _____ Water Surface Oils <input type="checkbox"/> Slick <input type="checkbox"/> Sheen <input type="checkbox"/> Globs <input type="checkbox"/> Flecks <input checked="" type="checkbox"/> None <input type="checkbox"/> Other _____ Turbidity (if not measured) <input type="checkbox"/> Clear <input type="checkbox"/> Slightly turbid <input type="checkbox"/> Turbid <input type="checkbox"/> Opaque <input checked="" type="checkbox"/> Stained <input type="checkbox"/> Other _____		
SEDIMENT/SUBSTRATE	Odors <input checked="" type="checkbox"/> Normal <input type="checkbox"/> Sewage <input type="checkbox"/> Petroleum <input type="checkbox"/> Chemical <input type="checkbox"/> Anaerobic <input type="checkbox"/> None <input type="checkbox"/> Other _____ Deposits <input type="checkbox"/> Sludge <input type="checkbox"/> Sawdust <input type="checkbox"/> Paper fiber <input checked="" type="checkbox"/> Sand <input type="checkbox"/> Relict shells <input checked="" type="checkbox"/> Other <u>silt</u> Oils <input checked="" type="checkbox"/> Absent <input type="checkbox"/> Slight <input type="checkbox"/> Moderate <input type="checkbox"/> Profuse Looking at stones which are not deeply embedded, are the undersides black in color? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <u>(but very little gravel or smaller sizes)</u>		

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	Diameter	% Composition in Sampling Reach	Substrate Type	Characteristic	% Composition in Sampling Area
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	30
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")				
Gravel	2-64 mm (0.1"-2.5")	5	Muck-Mud	black, very fine organic (FPOM)	5
Sand	0.06-2mm (gritty)	70			
Silt	0.004-0.06 mm	25			
Clay	< 0.004 mm (slick)		Marl	grey, shell fragments	

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME <u>HGMC-4</u>	LOCATION <u>Kershaw, SC</u>	
STATION # _____ RIVERMILE _____	STREAM CLASS _____	
LAT <u>See below</u> LONG _____	RIVER BASIN <u>Little Lynches</u>	
STORET # _____	AGENCY _____	
INVESTIGATORS <u>DOB, MHF, EU</u>		
FORM COMPLETED BY <u>DOB</u>	DATE <u>4/5/12</u> TIME <u>1:00</u> AM <input checked="" type="radio"/> PM <input type="radio"/>	REASON FOR SURVEY <u>Haile EIS</u>

Downstream N34.58415 W80.53170 Upstream N34.58402 W80.53136 NAD83

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. <i>undercut banks and LWD, AV, and some root wads primary habitat</i>	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.	
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.	
SCORE	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow. <i>shallow, moderate depth</i>	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.	
SCORE	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0
4. Sediment Deposition Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.	
SCORE	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0
5. Channel Flow Status Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.	
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Habitat Parameter	Condition Category																				
	Optimal					Suboptimal					Marginal					Poor					
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.					Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.					Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.					Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.					
SCORE	(20)	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)					The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.					The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.					Channel straight; waterway has been channelized for a long distance.					
SCORE	20	19	18	17	16	15	(14)	13	12	11	10	9	8	7	6	5	4	3	2	1	0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.					Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.					
SCORE __ (LB)	Left Bank 10 (9)					8 7 6					5 4 3					2 1 0					
SCORE __ (RB)	Right Bank (10) 9					8 7 6					5 4 3					2 1 0					
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.					
SCORE __ (LB)	Left Bank (10) 9					8 7 6					5 4 3					2 1 0					
SCORE __ (RB)	Right Bank (10) 9					8 7 6					5 4 3					2 1 0					
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.					Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.					Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.					Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.					
SCORE __ (LB)	Left Bank 10 9					8 7 (6)					5 4 3					2 1 0					
SCORE __ (RB)	Right Bank (10) 9					8 7 6					5 4 3					2 1 0					

Total Score _____

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES
STREAM ASSESSMENT DATA SHEET



DATE: 9/5/12

SITE NUMBER: HGMC-5

HABITAT CHARACTERIZATION	Depth (m) ft.	Velocity (m/s)	Substrate: inorganic(mm) or organic category	Width Depth (m) ft.	Run Velocity (m/s)	Substrate: inorganic(mm) or organic category	LWD (M)	Notes
1	1.25	0.20	silt	26	27	Beaver Pool *	2 rootballs	stable
2	3.2	0.01	CPOM	27	22	B. Pool		* immediately upstream of beaver dam
3	3.32	0.11	CPOM	28	—	B. Pool		
4	1.6	0.09	silt	29	—	B. Pool	0.2M x 2	1.5m stable plus rootwad
5	0.65	0.18	FWD	30	17.2	B. Pool		
6	1.12	0.23	CPOM	31	—	B. Pool		
7	1.35	0.12	silt	32	—	B. Pool		
8	2.50	0.13	silt	33	30	B. Pool	0.1 x 1M	stable
9	2.58	0.12	LWD	34	10.2	B. Pool	0.2 x 4M	stable (x2)
10	0.55	0.25	AV	35	6.2	B. RUN	0.1 x 3M	stable
11	2.45	0.14	silt	36	—	B. RUN	0.1 x 2M	stable (2)
12	1.79	0.15	FWD	37	5.1	B. RUN	0.05 x 2M 0.2 x 3M	stable stable
13	0.62	0.11	AV	38	—	B. RUN	0.1 x 1.5M	
14	1.72	0.11	silt	39	5.8	B. RUN	0.25 x 2.5M 0.2 x 1.5M 0.15 x 2M	stable stable stable
15				40				
16				41				
17				42				
18				43				
19				44				
20				45				
21				46				
22				47				
23				48				
24				49				
25				50				

HABITAT NOTES	
— 1. = large pile of beaver sticks underwater	
— Reach shortened to 53M due to beaver ponds. Downstream start is at beaver dam; upstream end is at base of next beaver dam.	
— 3 species SAV (see photos) and filamentous algae	
— Mix of trees and shrubs and many	

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME <u>HGMC-5</u>	LOCATION <u>Kershaw, SC</u>	
STATION # _____ RIVERMILE _____	STREAM CLASS _____	
LAT _____ LONG _____	RIVER BASIN <u>Little Lynches</u>	
STORET # _____	AGENCY _____	
INVESTIGATORS <u>DJB, MHF, EU</u>		
FORM COMPLETED BY <u>DJB</u>	DATE <u>4/5/12</u> TIME <u>3:15</u> AM <input checked="" type="radio"/> PM <input type="radio"/>	REASON FOR SURVEY <u>Wile EIS</u>

WEATHER CONDITIONS	<p>Now</p> <p><input type="checkbox"/> storm (heavy rain)</p> <p><input type="checkbox"/> rain (steady rain)</p> <p><input type="checkbox"/> showers (intermittent)</p> <p><u>10</u> % <input checked="" type="checkbox"/> %cloud cover</p> <p><input type="checkbox"/> clear/sunny</p>	<p>Past 24 hours</p> <p><input type="checkbox"/> storm (heavy rain)</p> <p><input type="checkbox"/> rain (steady rain)</p> <p><input type="checkbox"/> showers (intermittent)</p> <p><input type="checkbox"/> %cloud cover</p> <p><input checked="" type="checkbox"/> clear/sunny</p>	<p>Has there been a heavy rain in the last 7 days? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <u>evening of 4/3/12 but did not</u></p> <p>Air Temperature <u>75</u> °F <u>last long or raise</u></p> <p>Other <u>stream levels the next day</u></p>
SITE LOCATION/MAP	<p>Draw a map of the site and indicate the areas sampled (or attach a photograph)</p> <p><u>See photos</u></p>		
STREAM CHARACTERIZATION	<p>Stream Subsystem <input checked="" type="checkbox"/> Perennial <input type="checkbox"/> Intermittent <input type="checkbox"/> Tidal</p> <p>Stream Origin <input type="checkbox"/> Glacial <input checked="" type="checkbox"/> Spring-fed <input type="checkbox"/> Non-glacial montane <input type="checkbox"/> Mixture of origins <input type="checkbox"/> Swamp and bog <input type="checkbox"/> Other _____</p> <p>Stream Type <input type="checkbox"/> Coldwater <input checked="" type="checkbox"/> Warmwater</p> <p>Catchment Area _____ km²</p>		

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES	Predominant Surrounding Landuse <input checked="" type="checkbox"/> Forest <input type="checkbox"/> Commercial <input type="checkbox"/> Field/Pasture <input type="checkbox"/> Industrial <input type="checkbox"/> Agricultural <input checked="" type="checkbox"/> Other <u>clear cuts</u> <input type="checkbox"/> Residential <u>wellpods/timber harvest</u>	Local Watershed NPS Pollution <input checked="" type="checkbox"/> No evidence <input type="checkbox"/> Some potential sources <input type="checkbox"/> Obvious sources Local Watershed Erosion <input checked="" type="checkbox"/> None <input type="checkbox"/> Moderate <input type="checkbox"/> Heavy
RIPARIAN VEGETATION (18 meter buffer)	Indicate the dominant type and record the dominant species present <input checked="" type="checkbox"/> Trees <input checked="" type="checkbox"/> Shrubs <input type="checkbox"/> Grasses <input type="checkbox"/> Herbaceous dominant species present <u>Mix of all 4 present; red maple, pine, alder, blackberry</u>	
INSTREAM FEATURES <u>See S.C. data sheet</u>	Estimated Reach Length <u>100</u> m Estimated Stream Width _____ m Sampling Reach Area _____ m ² Area in km ² (m ² x1000) _____ km ² Estimated Stream Depth _____ m Surface Velocity _____ m/sec (at thalweg) Canopy Cover <input checked="" type="checkbox"/> Partly open <input type="checkbox"/> Partly shaded <input type="checkbox"/> Shaded High Water Mark <u>N/A</u> m Proportion of Reach Represented by Stream Morphology Types <input type="checkbox"/> Riffle <input type="checkbox"/> Run <u>35</u> % <input checked="" type="checkbox"/> Pool <u>65</u> % <u>All due to beaver activity</u> Channelized <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Dam Present <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <u>but beaver dams</u>	
LARGE WOODY DEBRIS	LWD _____ m ² Density of LWD _____ m ² /km ² (LWD/ reach area) <u>See S.C. data sheet</u>	
AQUATIC VEGETATION	Indicate the dominant type and record the dominant species present <input checked="" type="checkbox"/> Rooted emergent <input type="checkbox"/> Rooted submergent <input type="checkbox"/> Rooted floating <input type="checkbox"/> Free floating <input type="checkbox"/> Floating Algae <input checked="" type="checkbox"/> Attached Algae <u>(See photo)</u> dominant species present <u>4 AV species and filamentous algae</u> Portion of the reach with aquatic vegetation <u>60</u> %	
WATER QUALITY	Temperature <u>21.85</u> °C Specific Conductance <u>0.022</u> mS/cm Dissolved Oxygen <u>8.84</u> mg/L pH <u>4.53</u> Turbidity <u>7.6</u> NTU WQ Instrument Used <u>Same as R10-2</u> TDS <u>0.015</u> g/L Water Odors <input checked="" type="checkbox"/> Normal/None <input type="checkbox"/> Sewage <input type="checkbox"/> Petroleum <input type="checkbox"/> Chemical <input type="checkbox"/> Fishy <input type="checkbox"/> Other _____ Water Surface Oils <input checked="" type="checkbox"/> Slick <input type="checkbox"/> Sheen <input type="checkbox"/> Globbs <input type="checkbox"/> Flecks <input checked="" type="checkbox"/> None <input type="checkbox"/> Other _____ Turbidity (if not measured) <input type="checkbox"/> Clear <input type="checkbox"/> Slightly turbid <input type="checkbox"/> Turbid <input type="checkbox"/> Opaque <input checked="" type="checkbox"/> Stained <input type="checkbox"/> Other _____	
SEDIMENT/SUBSTRATE	Odors <input checked="" type="checkbox"/> Normal <input type="checkbox"/> Sewage <input type="checkbox"/> Petroleum <input type="checkbox"/> Chemical <input type="checkbox"/> Anaerobic <input type="checkbox"/> None <input type="checkbox"/> Other _____ Deposits <input type="checkbox"/> Sludge <input type="checkbox"/> Sawdust <input type="checkbox"/> Paper fiber <input type="checkbox"/> Sand <input type="checkbox"/> Relict shells <input checked="" type="checkbox"/> Other <u>silt</u> Oils <input checked="" type="checkbox"/> Absent <input type="checkbox"/> Slight <input type="checkbox"/> Moderate <input type="checkbox"/> Profuse Looking at stones which are not deeply embedded, are the undersides black in color? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <u>NA - no stones</u>	

• = dominant

* sweet gum

grasses, carex spp.

ferns, juncus,

rhododendron

ferns

AV

1. Sparganium angustifolium

2. Juncus sp.

3. Carex sp. 1

4. Carex sp. 2

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	Diameter	% Composition in Sampling Reach	Substrate Type	Characteristic	% Composition in Sampling Area
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	40
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	45
Gravel	2-64 mm (0.1"-2.5")				
Sand	0.06-2mm (gritty)	20 fine	Marl	grey, shell fragments	
Silt	0.004-0.06 mm	80			
Clay	< 0.004 mm (slick)				

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME <u>#GMC-5</u>	LOCATION <u>Kershaw, SC</u>	
STATION # _____ RIVERMILE _____	STREAM CLASS _____	
LAT <u>See below</u> LONG _____	RIVER BASIN <u>Little Lyncas</u>	
STORET # _____	AGENCY _____	
INVESTIGATORS <u>DOB, MHF, EU</u>		
FORM COMPLETED BY <u>DOB</u>	DATE <u>4/5/12</u> TIME <u>3:15</u> AM <input checked="" type="radio"/> PM <input type="radio"/>	REASON FOR SURVEY <u>Habit EIS</u>

Downstream N 34.58143 W 80.53366 Upstream N 34.58173 W 80.53328 NAD 83

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. <u>LWD and aquatic veg primary habitat</u>	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 <u>8</u> 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 <u>13</u> 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools. <u>Brace Pond</u>	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	<u>10</u> 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 <u>7</u> 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	<u>20</u> 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

- L. W. or oblique
> 1/2 cross section = large
Deep > 1m

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Habitat Parameter	Condition Category																				
	Optimal					Suboptimal					Marginal					Poor					
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.					Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.					Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.					Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.					
SCORE	(20)	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)					The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.					The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.					Channel straight; waterway has been channelized for a long distance.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	(8)	7	6	5	4	3	2	1	0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.					Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.					
SCORE ____ (LB)	Left Bank 10 (9)					8 7 6					5 4 3					2 1 0					
SCORE ____ (RB)	Right Bank 10 (9)					8 7 6					5 4 3					2 1 0					
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.					
SCORE ____ (LB)	Left Bank (10) 9					8 7 6					5 4 3					2 1 0					
SCORE ____ (RB)	Right Bank (10) 9					8 7 6					5 4 3					2 1 0					
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.					Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.					Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.					Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.					
SCORE ____ (LB)	Left Bank (10) 9					8 7 6					5 4 3					2 1 0					
SCORE ____ (RB)	Right Bank (10) 9					8 7 6					5 4 3					2 1 0					

Total Score _____

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES
STREAM ASSESSMENT DATA SHEET



DATE: 4/3/12

SITE NUMBER: Camp Branch

CB4-S12

Pool/Riffle LWD (m)

HABITAT CHARACTERIZATION	Depth (m) ft	Velocity (m/s)	Substrate: inorganic(mm) or organic category	Width Depth (m) ft	Run Velocity (m/s)	Substrate: inorganic(mm) or organic category
①	1.35	0.20	CPOM	26	11.8	Beaver Pool/ RUN
②	1.8	0.21	CPOM AV	27	—	B. Pool/ RUN
③	0.9	0.21	CPOM AV	28	—	B. Pool/ RUN
④	0.3	0.29	silt	29	—	RUN
⑤	0.38	0.23	CPOM	30	13.4	RUN
⑥	0.5	0.30	CPOM AV	31	—	RUN
7	0.25	0.33	FWD	32	—	RUN
8	0.95	0.16	silt	33	—	pool
9	0.35	0.24	Z	34	—	RUN
10	1.39	0.19	silt	35	11.1	Beaver Pool
11	1.30	0.18	CPOM	36	—	B. pool
12	0.2	0.25	sand	37	—	B. pool
13	0.4	0.33	sand	38	—	RUN
14	0.55	0.32	CPOM	39	—	RUN
15	0.25	0.34	sand	40	4.7	RUN
16	0.2	0.51	sand	41	—	RUN
17	0.31	0.37	sand	42	—	RUN
18	0.4	0.28	CPOM	43	—	RUN
19	0.35	0.34	sand	44	—	RUN
20	0.5	0.13	CPOM	45	19.5	B. Pool
21	1.55	0.07	silt	46	—	B. pool
22	0.48	0.13	CPOM	47	—	B. pool
23	0.75	0.17	CPOM	48	—	B. pool
24	0.9	0.08	silt	49	—	B. pool
25	0.3	0.16	silt	50	5.8	RUN

HABITAT NOTES	- Multiple small beaver dams/pools. Upstream boundary of reach is base of very large beaver dam/pool.
	- Many channels/braiding
	- Some areas choked with dense SAV.

0 = dense SAV
- immature forest
- ~~species~~ SAV and filamentous algae

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME <u>Camp Branch CB4</u>		LOCATION <u>Kershaw, SC</u>	
STATION # _____ RIVERMILE _____		STREAM CLASS _____	
LAT _____ LONG _____		RIVER BASIN <u>Little Lynches</u>	
STORET # _____		AGENCY _____	
INVESTIGATORS <u>DOB, MHF</u>			
FORM COMPLETED BY <u>DOB</u>		DATE <u>9/3/12</u> TIME <u>1:50</u> AM <input checked="" type="radio"/> PM	REASON FOR SURVEY <u>Hale EIS</u>

WEATHER CONDITIONS	<p>Now</p> <p><input type="checkbox"/> storm (heavy rain)</p> <p><input type="checkbox"/> rain (steady rain)</p> <p><input checked="" type="checkbox"/> showers (intermittent)</p> <p><input type="checkbox"/> %cloud cover</p> <p><input type="checkbox"/> clear/sunny</p>	<p>Past 24 hours</p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input checked="" type="checkbox"/> %</p>	<p>Has there been a heavy rain in the last 7 days?</p> <p><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <u>just some rain</u></p> <p>Air Temperature <u>78</u> °F</p> <p>Other _____</p>
	<p>SITE LOCATION/MAP</p> <p>Draw a map of the site and indicate the areas sampled (or attach a photograph)</p> <p><u>See photos</u></p>		
<p>STREAM CHARACTERIZATION</p> <p><u>May dry out part of the year except beaver dams/pools</u></p>	<p>Stream Subsystem</p> <p><input checked="" type="checkbox"/> Perennial <input type="checkbox"/> Intermittent <input type="checkbox"/> Tidal</p> <p>Stream Origin</p> <p><input type="checkbox"/> Glacial <input checked="" type="checkbox"/> Spring-fed</p> <p><input type="checkbox"/> Non-glacial montane <input type="checkbox"/> Mixture of origins</p> <p><input checked="" type="checkbox"/> Swamp and bog <input type="checkbox"/> Other _____</p> <p><u>Beaver dams</u></p>	<p>Stream Type</p> <p><input type="checkbox"/> Coldwater <input checked="" type="checkbox"/> Warmwater</p> <p>Catchment Area _____ km²</p>	

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES	Predominant Surrounding Landuse <input checked="" type="checkbox"/> Forest <input type="checkbox"/> Commercial <input type="checkbox"/> Field/Pasture <input type="checkbox"/> Industrial <input type="checkbox"/> Agricultural <input type="checkbox"/> Other _____ <input type="checkbox"/> Residential		Local Watershed NPS Pollution <input checked="" type="checkbox"/> No evidence <input type="checkbox"/> Some potential sources <input type="checkbox"/> Obvious sources
	Local Watershed Erosion <input checked="" type="checkbox"/> None <input type="checkbox"/> Moderate <input type="checkbox"/> Heavy		
RIPARIAN VEGETATION (18 meter buffer)	Indicate the dominant type and record the dominant species present <input checked="" type="checkbox"/> Trees <input checked="" type="checkbox"/> Shrubs <input type="checkbox"/> Grasses <input type="checkbox"/> Herbaceous dominant species present <u>Mix of all 4 present but mostly trees and shrubs</u>		
INSTREAM FEATURES <u>See S.C. data sheet</u>	Estimated Reach Length <u>100</u> m Canopy Cover <input checked="" type="checkbox"/> but mostly shaded <input type="checkbox"/> Partly open <input checked="" type="checkbox"/> Partly shaded <input checked="" type="checkbox"/> Shaded Estimated Stream Width _____ m Sampling Reach Area _____ m ² High Water Mark <u>NA</u> m Area in km ² (m ² x 1000) _____ km ² Proportion of Reach Represented by Stream Morphology Types <input type="checkbox"/> Riffle <u>0</u> % <input checked="" type="checkbox"/> Run <u>50</u> % <input type="checkbox"/> Pool <u>50</u> % (beaver dams/pools) Estimated Stream Depth _____ m Surface Velocity _____ m/sec Channelized <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Dam Present <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No but beaver dams		
LARGE WOODY DEBRIS	LWD _____ m ² Density of LWD _____ m ² /km ² (LWD/ reach area) <u>See S.C. data sheet</u>		
AQUATIC VEGETATION	Indicate the dominant type and record the dominant species present <input checked="" type="checkbox"/> Rooted emergent <input type="checkbox"/> Rooted submergent <input type="checkbox"/> Rooted floating <input type="checkbox"/> Free floating <input type="checkbox"/> Floating Algae <input type="checkbox"/> Attached Algae dominant species present <u>3 species AV present and filamentous algae (see photos)</u> Portion of the reach with aquatic vegetation <u>40</u> %		
WATER QUALITY	Temperature <u>19.17</u> °C Water Odors <input checked="" type="checkbox"/> Normal/None <input type="checkbox"/> Sewage <input type="checkbox"/> Petroleum <input type="checkbox"/> Chemical <input type="checkbox"/> Fishy <input type="checkbox"/> Other _____ Specific Conductance <u>0.021</u> mS/cm Dissolved Oxygen <u>9.13</u> mg/L Water Surface Oils <input type="checkbox"/> Slick <input type="checkbox"/> Sheen <input type="checkbox"/> Globbs <input type="checkbox"/> Flecks <input checked="" type="checkbox"/> None <input type="checkbox"/> Other <u>Natural sheen (angular)</u> pH <u>5.46</u> Turbidity <u>7.5</u> NTU Turbidity (if not measured) <input type="checkbox"/> Clear <input type="checkbox"/> Slightly turbid <input type="checkbox"/> Turbid <input type="checkbox"/> Opaque <input checked="" type="checkbox"/> Stained <input type="checkbox"/> Other _____ WQ Instrument Used <u>Same as R10-2</u> <u>TDS 0.015 g/L</u>		
SEDIMENT/SUBSTRATE	Odors <input type="checkbox"/> Normal <input type="checkbox"/> Sewage <input type="checkbox"/> Petroleum <input type="checkbox"/> Chemical <input checked="" type="checkbox"/> Anaerobic <input type="checkbox"/> None <input type="checkbox"/> Other _____ Deposits <input type="checkbox"/> Sludge <input type="checkbox"/> Sawdust <input type="checkbox"/> Paper fiber <input type="checkbox"/> Sand <input type="checkbox"/> Relict shells <input checked="" type="checkbox"/> Other <u>CPOM, silt</u> Oils <input checked="" type="checkbox"/> Absent <input type="checkbox"/> Slight <input type="checkbox"/> Moderate <input type="checkbox"/> Profuse Looking at stones which are not deeply embedded, are the undersides black in color? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <u>No large stones</u>		

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	Diameter	% Composition in Sampling Reach	Substrate Type	Characteristic	% Composition in Sampling Area
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	60
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")				
Gravel	2-64 mm (0.1"-2.5")		Muck-Mud	black, very fine organic (FPOM)	10
Sand	0.06-2mm (gritty)	40			
Silt	0.004-0.06 mm	60			
Clay	< 0.004 mm (slick)		Marl	grey, shell fragments	

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME <u>Camp Branch CB4</u>	LOCATION <u>Keeshaw, SC</u>	
STATION # _____ RIVERMILE _____	STREAM CLASS _____	
LAT <u>See below</u> LONG _____	RIVER BASIN <u>Little Lyncches</u>	
STORET # _____	AGENCY _____	
INVESTIGATORS <u>DJB, MHF</u>		
FORM COMPLETED BY <u>DJB</u>	DATE <u>4/3/12</u> TIME <u>1:50</u> AM <input checked="" type="radio"/> PM	REASON FOR SURVEY <u>Haile EIS</u>

GTS downstream N 34.61013 W 80.55411 upstream N 34.61083 W 80.55447 NAD 83

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11 <u>11</u>	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 <u>13</u> 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools. <u>Beaver Pond</u>	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 <u>8</u> 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 <u>7</u> 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 <u>14</u> 13 12 11	10 9 8 7 6	5 4 3 2 1 0

• L, W or oblique
• > 1/2 cross section N = large
• deep > 1m

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Habitat Parameter	Condition Category																				
	Optimal					Suboptimal					Marginal					Poor					
6. Channel Alteration Channelization or dredging absent or minimal; stream with normal pattern. <i>braiding</i>						Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.					Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.					Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
7. Channel Sinuosity The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)						The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.					The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.					Channel straight; waterway has been channelized for a long distance.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
8. Bank Stability (score each bank) Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.						Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.					Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.					
SCORE ____ (LB)	Left Bank					8					5					2					
SCORE ____ (RB)	Right Bank					8					5					2					
9. Vegetative Protection (score each bank) More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.						70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.					
SCORE ____ (LB)	Left Bank					8					5					2					
SCORE ____ (RB)	Right Bank					8					5					2					
10. Riparian Vegetative Zone Width (score each bank riparian zone) Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.						Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.					Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.					Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.					
SCORE ____ (LB)	Left Bank					8					5					2					
SCORE ____ (RB)	Right Bank					8					5					2					

Total Score _____

Reach heavily influenced by Beaver ponds/braiding. See SC. datasheet

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES
STREAM ASSESSMENT DATA SHEET



DATE: 4/3/12

SITE NUMBER: Camp Branch

CB5-512

Pool/Riffle/ LWD (m)

HABITAT CHARACTERIZATION		Depth (m) ft	Velocity (m/s)	Substrate: inorganic(mm) or organic category		Width Depth (m) ft	Run Velocity (m/s)	Substrate: inorganic(mm) or organic category
	1	0.48	0.12	boulder	26	4.6	Run	
	2	0.2	0.27	boulder	27	—	riffle	
	3	0.3	0.12	FPOM	28	—	run	
	4	0.3	0.12	clay	29	—	pool	
	5	0.4	0.12	clay	30	7.9	pool	
	6	0.4	0.26	39	31	—	run	
	7	0.6	0.24	CPOM	32	—	pool	
	8	0.3	0.34	sand	33	—	riffle	
	9	0.3	0.24	sand	34	—	run	0.08 x 1 m unstable
	10	1.15	0.24	12	35	8.0	riffle	
	11	0.72	0.07	silt	36	—	pool	
	12	0.61	0.37	3	37	—	pool	0.05 x 1.5 m unstable
	13	0.2	0.29	sand	38	—	run	
	14	0.71	0.14	FPOM	39	—	pool	
	15	0.59	0.18	X 223	40	4.2	run	
	16	0.32	0.21	sand	41	—	riffle	
	17	0.28	0.31	11	42	—	pool	0.04 x 1.25 m unstable
	18	0.29	0.23	CPOM	43	—	run	
	19	0.37	0.24	103	44	—	run	
	20	0.37	0.26	sand	45	4.4	run	
	21	0.2	0.21	86	46	—	riffle	
	22	0.49	-0.03	AV	47	—	run	
	23	0.47	0.19	silt	48	—	run	
	24	0.4	0.10	silt	49	—	run	
	25	0.37	0.17	25	50	5.3	run	

HABITAT NOTES		
	- grass road and ATV trail next to stream on east side - immature forest - 4 species AV (see photos) and filamentous algae - dense riparian veg - shrubs, herbaceous, vines - series of small riffle, run, pool sequences	

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME <u>Camp Branch CBS</u>		LOCATION <u>Kershaw, SC</u>	
STATION # _____ RIVERMILE _____		STREAM CLASS _____	
LAT _____ LONG _____		RIVER BASIN <u>Little Lynches</u>	
STORET # _____		AGENCY _____	
INVESTIGATORS <u>DTB, MHF</u>			
FORM COMPLETED BY <u>DTB</u>		DATE <u>4/3/12</u> TIME <u>11:45</u> <u>AM</u> PM	REASON FOR SURVEY <u>Haile EIS</u>

WEATHER CONDITIONS	<p>Now</p> <p><input type="checkbox"/> storm (heavy rain)</p> <p><input type="checkbox"/> rain (steady rain)</p> <p><input checked="" type="checkbox"/> showers (intermittent)</p> <p><input type="checkbox"/> %cloud cover</p> <p><input type="checkbox"/> clear/sunny</p> <p><u>70</u> %</p>	<p>Past 24 hours</p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input checked="" type="checkbox"/> %</p>	<p>Has there been a heavy rain in the last 7 days?</p> <p><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <u>just some rain</u></p> <p>Air Temperature <u>75</u> °F</p> <p>Other _____</p>
	<p>SITE LOCATION/MAP</p> <p>Draw a map of the site and indicate the areas sampled (or attach a photograph)</p> <p><u>See photos</u></p>		
<p>STREAM CHARACTERIZATION</p> <p><u>May dry out portion of year</u></p>	<p>Stream Subsystem</p> <p><input checked="" type="checkbox"/> Perennial <input type="checkbox"/> Intermittent <input type="checkbox"/> Tidal</p> <p>Stream Origin</p> <p><input type="checkbox"/> Glacial <input checked="" type="checkbox"/> Spring-fed</p> <p><input type="checkbox"/> Non-glacial montane <input type="checkbox"/> Mixture of origins</p> <p><input type="checkbox"/> Swamp and bog <input type="checkbox"/> Other _____</p> <p>Stream Type</p> <p><input type="checkbox"/> Coldwater <input checked="" type="checkbox"/> Warmwater</p> <p>Catchment Area _____ km²</p>		

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(BACK)

WATERSHED FEATURES	Predominant Surrounding Landuse <input checked="" type="checkbox"/> Forest <input type="checkbox"/> Commercial <input type="checkbox"/> Field/Pasture <input type="checkbox"/> Industrial <input type="checkbox"/> Agricultural <input checked="" type="checkbox"/> Other <u>some pine plantation</u> <input type="checkbox"/> Residential		Local Watershed NPS Pollution <input checked="" type="checkbox"/> No evidence <input type="checkbox"/> Some potential sources <input type="checkbox"/> Obvious sources
RIPARIAN VEGETATION (18 meter buffer)	Indicate the dominant type and record the dominant species present <input checked="" type="checkbox"/> Trees <input checked="" type="checkbox"/> Shrubs <input checked="" type="checkbox"/> Grasses <input type="checkbox"/> Herbaceous dominant species present <u>Mix of all 4 - trees (pines and hardwoods), shrubs - elderberry</u>		Local Watershed Erosion <input checked="" type="checkbox"/> None <input type="checkbox"/> Moderate <input type="checkbox"/> Heavy
INSTREAM FEATURES <u>See S.C. data sheet</u>	Estimated Reach Length <u>100</u> m Estimated Stream Width _____ m Sampling Reach Area _____ m ² Area in km ² (m ² x 1000) _____ km ² Estimated Stream Depth _____ m Surface Velocity _____ m/sec (at thalweg)		Canopy Cover <input checked="" type="checkbox"/> Partly open <input type="checkbox"/> Partly shaded <input type="checkbox"/> Shaded High Water Mark <u>NA</u> m Proportion of Reach Represented by Stream Morphology Types <input type="checkbox"/> Riffle <u>10</u> % <input type="checkbox"/> Run <u>60</u> % <input type="checkbox"/> Pool <u>30</u> % Channelized <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Dam Present <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
LARGE WOODY DEBRIS	LWD _____ m ² Density of LWD _____ m ² /km ² (LWD/ reach area)		<u>See S.C. data sheet</u> <u>not much - unstable</u>
AQUATIC VEGETATION	Indicate the dominant type and record the dominant species present <input checked="" type="checkbox"/> Rooted emergent <input type="checkbox"/> Rooted submergent <input type="checkbox"/> Rooted floating <input type="checkbox"/> Free floating <input type="checkbox"/> Floating Algae <input type="checkbox"/> Attached Algae dominant species present <u>4 species - see photos, and some attached algae (see photos)</u> Portion of the reach with aquatic vegetation <u>30</u> %		<u>1. rush spp., 2. carex spp., 3. ?, 4. ?</u>
WATER QUALITY	Temperature <u>16.72</u> °C Specific Conductance <u>0.022</u> mS/cm Dissolved Oxygen <u>9.62</u> mg/L pH <u>5.87</u> Turbidity <u>14.4</u> NTU WQ Instrument Used <u>YSI 650MDS</u> <u>TDS 0.017 g/L</u> <u>YSI 6820</u>		Water Odors <input checked="" type="checkbox"/> Normal/None <input type="checkbox"/> Sewage <input type="checkbox"/> Petroleum <input type="checkbox"/> Chemical <input type="checkbox"/> Fishy <input type="checkbox"/> Other _____ Water Surface Oils <input checked="" type="checkbox"/> None <input type="checkbox"/> Sheen <input type="checkbox"/> Globbs <input type="checkbox"/> Flecks <input type="checkbox"/> Slack <input type="checkbox"/> Slightly turbid <input type="checkbox"/> Turbid <input type="checkbox"/> Opaque <input checked="" type="checkbox"/> Stained <input type="checkbox"/> Other _____ Turbidity (if not measured) <input type="checkbox"/> Clear <input type="checkbox"/> Slightly turbid <input type="checkbox"/> Turbid <input type="checkbox"/> Opaque <input checked="" type="checkbox"/> Stained <input type="checkbox"/> Other _____
SEDIMENT/SUBSTRATE	Odors <input checked="" type="checkbox"/> Normal <input type="checkbox"/> Sewage <input type="checkbox"/> Petroleum <input type="checkbox"/> Chemical <input type="checkbox"/> Anaerobic <input type="checkbox"/> None <input type="checkbox"/> Other _____ Oils <input checked="" type="checkbox"/> Absent <input type="checkbox"/> Slight <input type="checkbox"/> Moderate <input type="checkbox"/> Profuse		Deposits <input type="checkbox"/> Sludge <input type="checkbox"/> Sawdust <input type="checkbox"/> Paper fiber <input checked="" type="checkbox"/> Sand <input type="checkbox"/> Relict shells <input type="checkbox"/> Other <u>POM</u> Looking at stones which are not deeply embedded, are the undersides black in color? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

• dominant
 willow, red maple, tulip poplar
 virens, blackberry, Rudzoo, jewel
 poke weed, weed,
 grasses, poison ivy
 DWD
 AV
 1. Sparganium americanum
 2. Juncus sp.
 3. Carex sp.
 4. Murdannia kiesak

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	Diameter	% Composition in Sampling Reach	Substrate Type	Characteristic	% Composition in Sampling Area
Bedrock		<u>25</u>	Detritus	sticks, wood, coarse plant materials (CPOM)	<u>35</u>
Boulder	> 256 mm (10")	<u>15</u>	Muck-Mud	black, very fine organic (FPOM)	<u>5</u>
Cobble	64-256 mm (2.5"-10")	<u>15</u>	Marl	grey, shell fragments	
Gravel	2-64 mm (0.1"-2.5")	<u>10</u>			
Sand	0.06-2mm (gritty)	<u>30</u>			
Silt	0.004-0.06 mm	<u>25</u>			
Clay	< 0.004 mm (slick)	<u>45</u>			

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME <u>Camp Branch CBS</u>		LOCATION <u>Kershaw, SC</u>	
STATION # _____ RIVERMILE _____		STREAM CLASS _____	
LAT <u>see below</u> LONG _____		RIVER BASIN <u>Little Lynches</u>	
STORET # _____		AGENCY _____	
INVESTIGATORS <u>DJB, MHF</u>			
FORM COMPLETED BY <u>DJB</u>		DATE <u>4/3/12</u> TIME <u>11:45</u> <input checked="" type="radio"/> AM <input type="radio"/> PM	REASON FOR SURVEY <u>Haile FIS</u>

GPS downstream N34.60819 W80.55320 upstream N34.60878 W80.55389 NAD83

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

L, W or oblique
> 1/2 cross section =
large
deep > 1m

stream small naturally

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score _____

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES
STREAM ASSESSMENT DATA SHEET



DATE: 4/3/12

SITE NUMBER: Camp Branch
CB6-S12

Pool/Riffle LWD (m)

	Depth (m) ft	Velocity (m/s)	Substrate: inorganic(mm) or organic category		Width -Depth (m) ft	Run Velocity (m/s)	Substrate: inorganic(mm) or organic category
1	1.65	0.25	CPOM	26	16.6	pool	
2	0.9	0.24	CPOM	27	—	pool	
3	0.4	0.31	bedrock	28	—	run	
4	0.51	0.21	CPOM	29	—	run	
5	0.29	0.32	sand	30	5.9	run	
6	0.56	0.29	sand	31	—	run	
7	0.32	0.48	43	32	—	riffle	
8	0.15	0.22	3	33	—	riffle	
9	0.28	0.18	AV	34	—	riffle	run 0.1x4m unstable
10	0.3	0.31	22	35	6.9	riffle	0.2x3.5m unstable
11	0.3	0.25	76	36	—	riffle	
12	0.1	0.22	silt	37	—	run	0.2x4m unstable,
13	0.5	0.21	23	38	—	run	0.15x2m unstable
14	0.6	0.44	93	39	—	run	0.45x11m stable, 0.15x2.5m unstable
15	0.53	0.14	silt	40	11.1	pool	0.15x5m stable, 0.15x2.5m unstable
16	1.52	0.09	sand	41	—	pool	0.2x3m stable
17	0.3	0.25	1.5	42	—	run	0.2x2m stable
18	0.42	0.22	bedrock	43	—	run	
19	0.46 0.17	0.46	31	44	—	riffle	0.1x5m
20	0.2	0.21	sand	45	7.2	run	0.15x5m unstable
21	0.33	0.22	CPOM	46	—	run	0.15x2m unstable
22	0.39	0.18	5	47	—	run	0.2x6m stable
23	0.15	0.26	51	48	—	riffle	0.2x5.5m stable
24	0.45	0.28	19	49	—	run	0.15x3m stable
25	0.36	0.47	clay	50	5.6	run	

HABITAT NOTES	- Mostly mature forest	
	- 2 species AV (see photos) and filamentous algae	
	- generally open understory	
	- series of riffles and runs primarily	

**PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)**

STREAM NAME <u>Camp Branch CB6</u>		LOCATION <u>Keeshaw, SC</u>	
STATION # _____ RIVERMILE _____		STREAM CLASS _____	
LAT _____ LONG _____		RIVER BASIN <u>Little Lyncies</u>	
STORET # _____		AGENCY _____	
INVESTIGATORS <u>DJB, MHF</u>			
FORM COMPLETED BY <u>DJB</u>		DATE <u>4/3/12</u> TIME <u>6:00</u> AM <input checked="" type="radio"/> PM <input type="radio"/>	REASON FOR SURVEY <u>Hale EIS</u>

WEATHER CONDITIONS	<p>Now</p> <p><input type="checkbox"/> storm (heavy rain)</p> <p><input type="checkbox"/> rain (steady rain)</p> <p><input checked="" type="checkbox"/> 20% showers (intermittent)</p> <p><input type="checkbox"/> %cloud cover</p> <p><input type="checkbox"/> clear/sunny</p>	<p>Past 24 hours</p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p><input checked="" type="checkbox"/> %</p>	<p>Has there been a heavy rain in the last 7 days?</p> <p><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <u>just some rain</u></p> <p>Air Temperature <u>75° F</u></p> <p>Other _____</p>
	<p>SITE LOCATION/MAP</p> <p>Draw a map of the site and indicate the areas sampled (or attach a photograph)</p> <p><u>See photos</u></p>		
STREAM CHARACTERIZATION	<p>Stream Subsystem</p> <p><input checked="" type="checkbox"/> Perennial <input type="checkbox"/> Intermittent <input type="checkbox"/> Tidal</p> <p>Stream Origin</p> <p><input type="checkbox"/> Glacial <input checked="" type="checkbox"/> Spring-fed</p> <p><input type="checkbox"/> Non-glacial montane <input type="checkbox"/> Mixture of origins</p> <p><input type="checkbox"/> Swamp and bog <input type="checkbox"/> Other _____</p>		
	<p>Stream Type</p> <p><input type="checkbox"/> Coldwater <input checked="" type="checkbox"/> Warmwater</p> <p>Catchment Area _____ km²</p>		

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(BACK)

WATERSHED FEATURES	Predominant Surrounding Landuse <input checked="" type="checkbox"/> Forest <input type="checkbox"/> Commercial <input type="checkbox"/> Field/Pasture <input type="checkbox"/> Industrial <input type="checkbox"/> Agricultural <input type="checkbox"/> Other _____ <input type="checkbox"/> Residential		Local Watershed NPS Pollution <input checked="" type="checkbox"/> No evidence <input type="checkbox"/> Some potential sources <input type="checkbox"/> Obvious sources Local Watershed Erosion <input checked="" type="checkbox"/> None <input type="checkbox"/> Moderate <input type="checkbox"/> Heavy
RIPARIAN VEGETATION (18 meter buffer)	Indicate the dominant type and record the dominant species present <input checked="" type="checkbox"/> Trees <input type="checkbox"/> Shrubs <input type="checkbox"/> Grasses <input type="checkbox"/> Herbaceous dominant species present <u>All 4 present: elm, tulip poplar, red maple, cedar</u>		• sweet gum • dominant holly, ferns, grasses, poison ivy, dogwood vine (grape)
INSTREAM FEATURES <u>See S.C. Data sheet</u>	Estimated Reach Length <u>100</u> m Estimated Stream Width _____ m Sampling Reach Area _____ m ² Area in km ² (m ² x 1000) _____ km ² Estimated Stream Depth _____ m Surface Velocity _____ m/sec (at thalweg)		Canopy Cover <input type="checkbox"/> Partly open <input type="checkbox"/> Partly shaded <input checked="" type="checkbox"/> Shaded High Water Mark <u>NA</u> m Proportion of Reach Represented by Stream Morphology Types <input type="checkbox"/> Riffle _____ % <input type="checkbox"/> Run _____ % <input type="checkbox"/> Pool _____ % Channelized <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Dam Present <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
LARGE WOODY DEBRIS	LWD _____ m ² Density of LWD _____ m ² /km ² (LWD/ reach area) <u>See S.C. data sheet</u>		
AQUATIC VEGETATION	Indicate the dominant type and record the dominant species present <input checked="" type="checkbox"/> Rooted emergent <input type="checkbox"/> Rooted submergent <input type="checkbox"/> Rooted floating <input type="checkbox"/> Free floating <input type="checkbox"/> Floating Algae <input type="checkbox"/> Attached Algae dominant species present <u>3 AV species (see photos) and filamentous algae</u> Portion of the reach with aquatic vegetation <u>45</u> %		AV species
WATER QUALITY	Temperature <u>20.73</u> °C Specific Conductance <u>0.025</u> mS/cm Dissolved Oxygen <u>8.78</u> pH <u>6.21</u> NTU Turbidity <u>12.3</u> WQ Instrument Used <u>same as R10-2</u> <u>TDS 0.08 g/L</u>		Water Odors <input checked="" type="checkbox"/> Normal/None <input type="checkbox"/> Sewage <input type="checkbox"/> Petroleum <input type="checkbox"/> Chemical <input type="checkbox"/> Fishy <input type="checkbox"/> Other _____ Water Surface Oils <input type="checkbox"/> Slick <input type="checkbox"/> Sheen <input type="checkbox"/> Globs <input type="checkbox"/> Flecks <input checked="" type="checkbox"/> None <input type="checkbox"/> Other _____ Turbidity (if not measured) <input type="checkbox"/> Clear <input type="checkbox"/> Slightly turbid <input type="checkbox"/> Turbid <input type="checkbox"/> Opaque <input checked="" type="checkbox"/> Stained <input type="checkbox"/> Other _____
SEDIMENT/SUBSTRATE	Odors <input checked="" type="checkbox"/> Normal <input type="checkbox"/> Sewage <input type="checkbox"/> Petroleum <input type="checkbox"/> Chemical <input type="checkbox"/> Anaerobic <input type="checkbox"/> None <input type="checkbox"/> Other _____ Oils <input checked="" type="checkbox"/> Absent <input type="checkbox"/> Slight <input type="checkbox"/> Moderate <input type="checkbox"/> Profuse		Deposits <input type="checkbox"/> Sludge <input type="checkbox"/> Sawdust <input type="checkbox"/> Paper fiber <input type="checkbox"/> Sand <input type="checkbox"/> Relict shells <input checked="" type="checkbox"/> Other <u>silt (one pool)</u> Looking at stones which are not deeply embedded, are the undersides black in color? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	Diameter	% Composition in Sampling Reach	Substrate Type	Characteristic	% Composition in Sampling Area
Bedrock		<u>5</u>	Detritus	sticks, wood, coarse plant materials (CPOM)	<u>40</u>
Boulder	> 256 mm (10")	<u>10</u>			
Cobble	64-256 mm (2.5"-10")	<u>10</u>	Muck-Mud	black, very fine organic (FPOM)	<u>45</u>
Gravel	2-64 mm (0.1"-2.5")	<u>40</u>			
Sand	0.06-2mm (gritty)	<u>20</u>	Marl	grey, shell fragments	
Silt	0.004-0.06 mm	<u>15</u>			
Clay	< 0.004 mm (slick)	<u>45</u>			

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME <u>Camp Branch CB6</u>		LOCATION <u>Kershaw, SC</u>	
STATION # _____ RIVERMILE _____		STREAM CLASS _____	
LAT <u>See below</u> LONG _____		RIVER BASIN <u>Little Lyncies</u>	
STORET # _____		AGENCY _____	
INVESTIGATORS _____			
FORM COMPLETED BY _____		DATE <u>4/3/12</u> TIME <u>8:00</u> AM <input checked="" type="radio"/> PM <input type="radio"/>	REASON FOR SURVEY <u>Haile ELS</u>

Downstream N34.60430 W 80.55345 Upstream N34.60510 W 80.55311 NAD83

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 <u>16</u>	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 <u>16</u>	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools. <i>smaller stream naturally, but some good pool depth</i>	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 <u>7</u> 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	<u>10</u> 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 <u>12</u> 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Habitat Parameter	Condition Category																				
	Optimal					Suboptimal					Marginal					Poor					
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.					Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.					Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.					Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)					The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.					The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.					Channel straight; waterway has been channelized for a long distance.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.					Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.					
SCORE ____ (LB)	Left Bank	10	9			8	7	6			5	4	3			2	1	0			
SCORE ____ (RB)	Right Bank	10	9			8	7	6			5	4	3			2	1	0			
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.					
SCORE ____ (LB)	Left Bank	10	9			8	7	6			5	4	3			2	1	0			
SCORE ____ (RB)	Right Bank	10	9			8	7	6			5	4	3			2	1	0			
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.					Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.					Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.					Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.					
SCORE ____ (LB)	Left Bank	10	9			8	7	6			5	4	3			2	1	0			
SCORE ____ (RB)	Right Bank	10	9			8	7	6			5	4	3			2	1	0			

Total Score _____

Appendix B
Spring 2012 Aquatic
Habitat Assessment
Photographs
April 3 and 5, 2012



Photograph #1.
Haile Gold Mine Creek (HGMC3)
– Looking upstream within the
sample reach.



Photograph #2.
Haile Gold Mine Creek (HGMC3)
– Culvert at the upstream end of
the sample reach.

Appendix B
Spring 2012 Aquatic
Habitat Assessment
Photographs
April 3 and 5, 2012



Photograph #3.
Haile Gold Mine Creek (HGMC4)
– Looking upstream at the
downstream end of the sample
reach.



Photograph #4.
Haile Gold Mine Creek (HGMC4)
– Looking upstream within the
sample reach.

Appendix B
Spring 2012 Aquatic
Habitat Assessment
Photographs
April 3 and 5, 2012



Photograph #5.
Haile Gold Mine Creek (HGMC5)
– Looking upstream at the
downstream end of the sample
reach.



Photograph #6.
Haile Gold Mine Creek (HGMC5)
– Looking upstream at the
upstream end of the sample reach.

Appendix B
Spring 2012 Aquatic
Habitat Assessment
Photographs
April 3 and 5, 2012



Photograph #7.

Camp Branch (CB4) – Looking upstream at the downstream end of the sample reach.



Photograph #8.

Camp Branch (CB4) – Looking at impounded area at upstream end of sample reach.

Appendix B
Spring 2012 Aquatic
Habitat Assessment
Photographs
April 3 and 5, 2012



Photograph #9.

Camp Branch (CB5) – Looking upstream from the downstream end of the sample reach.



Photograph #10.

Camp Branch (CB5) – Looking upstream at upstream end of the sample reach.

Appendix B
Spring 2012 Aquatic
Habitat Assessment
Photographs
April 3 and 5, 2012



Photograph #11.

Camp Branch (CB6) – Looking upstream from the downstream end of the sample reach.



Photograph #12.

Camp Branch (CB6) – Looking upstream from the upstream end of the sample reach.

Appendix B
Spring 2012 Aquatic
Habitat Assessment
Photographs
April 3 and 5, 2012



Photograph #13.
Haile Gold Mine Creek (HGMC3)
– Example of natural in-stream
barrier, comprised of large root
wad.



Photograph #14.
Haile Gold Mine Creek (HGMC3)
– Example of natural in-stream
barrier, comprised of assorted
small and large woody debris.

Appendix B
Spring 2012 Aquatic
Habitat Assessment
Photographs
April 3 and 5, 2012



Photograph #15.
Haile Gold Mine Creek (HGMC3)
– Example of potential man-made barrier via road crossing through large culvert.



Photograph #16.
Haile Gold Mine Creek (Between HGMC 4 and HGMC5) – Example of potential man-made barrier via road crossing through large culvert.



Haile Gold Mine

Spring 2012 Aquatic
Resource Surveys Report

Appendix C

Spring 2012 Resident Fish Community Species Field Notes and Photographs

4/4/12

0820 - Crew: DSB, EAU, MHF, JCL

John Alderman

Conduct tailgate HRS safety meeting.

0840 - Arrive at CB3 and gear up

Weather: fog and sunny 60s (morning)

Overnight: none dec mid 70s (afternoon)

0910 - Crew begin fish survey at CB3

0950 Use 2 backpack electrofishing units
and sample with one pass.

ESC Shocking Times: $1683 \times 2 = 3,366$ sec

0950 - Process and speciate/enumerate

1030 surveyed fish

1040 - Demob from site.

Water Quality (YSI 650 MDS)

Temp (°C):

17.41

pH:

6.91

Cond (mS/cm):

0.032

Turbid (NTU):

17.1

DO (mg/L):

9.90

TDS (g/L):

0.024

Flow (m/s):

0.35

4/4/12

Species Photo Log (over all locations/dates)

- 1 ✓ creek chub
- 2 ✓ bluehead chub
- 3 ✓ rosyside dace
- 4 ✓ greenhead shiner
- 5 ✓ creek chubsucker
- 6 ✓ green sunfish
- 7 ✓ redbreast sunfish
- 8 ✓ margined madtom
- 9 ✓ pirate perch
- 10 ✓ tessellated darter
- 11 ~~sandhills chub~~ sandhills chub
- 12 mud sunfish
- 13 redfin pickerel
- 14 yellow bullhead
- 15 highfin shiner
- 16 swallowtail shiner
- 17 bluegill
- 18 flat bullhead
- 19 dollar sunfish
- 20 largemouth bass
- 21 greenfin shiner
- 22 pumpkinseed
- 23 brassy jumprock
- 24 eastern mosquitofish
- 25 yellow perch
- 26 dusky shiner
- 27 ~~Piedmont darter~~
- 28 Golden shiner *

* no picture obtained

Rite in the Rain

4/4/2012

1105 - Crew mobilizes to CBS (R10-2)

Crew: JCV, DSB, EAV, MHF, John Alderman

Use one backpack electrofishing unit

Complete one sample pass.

Shocking time: 1,984 sec

1110 - Conduct fish survey

- 1150

1205 Process fish

- 1220

1235 Crew demobs from site

Water Quality

Temp (°C): 20.14

pH: 5.70

Cond (ns/cm): 0.023

Turbid (NTU): 24.2

DO (mg/L): 9.35

TDS (g/L): 0.016

Flow (m/s): 0.24

Herps Observed: northern water snake

4/4/2012

1420 - Crew arrives at walk-in point for CBZ and CBG.

1440 - Crew arrives at CBG (R10-6)

Crew: JCV, DSB, EAV, MHF, John Alderman

Use two backpack electrofishing units

Complete one sample pass

Shocking time: 1940 sec

1445 - Crew conducts survey

- 1515 Crew processes fish

1520 - Crew demobilizes from site

Water Quality

Temp (°C): 22.63

pH: 6.27

Cond (ns/cm): 0.024

Turb (NTU): 12.6

DO (mg/L): 8.86

TDS (g/L): 0.017

Flow (m/s): 0.43

Herps: cricket frog, two-lined salamander

Rite in the Rain

4/4/12

Crew mobilizes to CBZ.

Crew: DJB, EAU, JCV, MHE, John Alderman

Crew uses one electrofishing unit

Crew completes one pass.

Shocking time: 3428 sec

Crew conducts survey and

processes intermittently

Crew processes fish from survey

1715

1750 - Crew demobilizes from site

Water Quality

Temp (C): 22.30

pH : 6.35

Cond (uS/cm): 0.027

Turb (NTU): 19.2

DO (mg/L): 8.68

TDS (g/L): 0.019

Flow (m/s): 0.41

4/5/12

Crew: DJB, EAU, JCV, MHE

John Alderman

Weather: mid 60s, mostly cloudy (morning)

Oversight: none

0815 - 0900 Gearing and mobilize to CBS walk-in point

0900 - 0910 Conduct tailgate HES meeting

Creek Chub vs. Sandhills Chub

0910 - 1000 - diagnostics on chubs

Observed at CBS:

- prominent black spot at anterior base of dorsal fin

- lateral line scale count 50 - 52

- dorsal fin rays 8

\therefore Creek chub

Photo on site taken

4/5/12

Crew mobilizes to CB4 (R10-4)

1015

Crew conducts electrofishing survey

-1050

with 2 units, perform single pass.

Shocking time: $1409 + 1210 = 2619$ secs

1050

Crew specimates and enumerates

-1100

survived fish

1100

Crew demobilizes from CB4

-1110

Water Quality

Temp (°C): 17.61

pH: 5.52

Cond (µm/cm): 0.019

Turb (NTU): 16.4

DO (mg/L): 7.33

TDS (g/L): 0.014

Flow (m/s): 0.19

* pool below beaver dam

Herps: leopard frogs, box turtle
anole

4/5/12

1230 - 6:30 Crew conducts

habitat assessments in upper HGMC

Weather: light rain, overcast mid 40-50°

810 Crew: DJB, EAU, JCV, MHF 4/6/12

-850 AES - John & Joseph Alderman

Conduct tailgate H&S meeting

Recon Little Lynches and Lower HGMC.

Slight turbidity from overnight rain.

Mobilize to HGMC1

Conditions are good. Clear with

more noticeable flow than observed during Fall 2011 survey.

850

Crew gears up and hikes

-910

in downstream end of HGMC1 to conduct fish community survey.

910

Recon HGMC1 reach.

-945

945 Crew uses one backpack electrofishing

-1010 unit and completes one pass.

Shock time, 585 sec

No fish observed

Herps: green frog, cricket frog species

Notes in the margin

4/6/12

HGMC 1 cont.

Water Quality

Temp (°C): 15.19

pH: 4.10

Cond (µS/cm): 0.032

Turb (NTU): 18.9

DO (mg/L): 6.23

TDS (g/L): 0.025

Flow (m/s): 0.21

4/6/12

1020 - Mobilize to downstream end of HGMC 3.

Crew: DJB, EAV, JCV, MHF

AGS - John & Joseph Alderman

1030 - Crew uses one backpack electrofishing unit and completes one sample pass.

Shock Time: 2,127 sec

1110 - Crew processes fish

1120

Water Quality

Temp (°C): 14.97

pH: 4.22

Cond (µS/cm): 0.026

Turb (NTU): 20.3

DO (mg/L): 8.75

TDS (g/L): 0.021

Flow (m/s): 0.22

Herps: n. dusky salamander, bullfrog
green frog

Rite in the Rain

4/6/2012

1240 - Crew mobilizes to HGM C4

Crew: DJB, EAV, JCV, MHF Weather: sunny mid 30's breezy
AES - John & Joseph Alderman

1250 - Crew conducts survey using one
1350 back pack electrofishing unit
and completes one sample pass

Shock Time: 2607 sec

1350 - Crew processes surveyed fish

1410 Senotilis lumber - lateral line scale count: 47-48
no dorsal spot dorsal fin rays: 9

Water Quality

Temp (°C) : 14.95
pH : 4.34
Cond (ms/cm) : 0.022
Turb (NTU) : 9.5
DO (mg/L) : 10.20
TDS (g/L) : 0.018

Flow (m/s) : 0.36

Herps: two-lined salamander, green frogs

4/6/2012

1450 - Crew mobilizes to HGM C5

Crew: DJB, EAV, JCV, MHF
AES - John & Joseph Alderman

1455 - Crew uses two backpack
-1520 electrofishing units to complete
one pass

Shocking Time: 1391 sec

1520 Crew processes surveyed fish

-1525 Senotilis lumber
lateral line scale count: 46-47
dorsal fin rays: 9

Water Quality

Temp (°C) : 17.16
pH : 4.45
Cond (ms/cm) : 0.024
Turb (NTU) : 7.1
DO (mg/L) : 10.09
TDS (g/L) : 0.018
Flow (m/s) : 0.26

Herps: ~~sixes~~ two-toed amphibia

Rite in the Rain

4/6/2012

1600 - Crew mobilizes to BCZ

Crew: DJB, EAU, JCV, MAF

AGS - John & Joseph Alderman

1605 - Crew uses two backpack electrofishing units to survey and completes one pass

Shock time: 1781 + 381 = 3162 sec

1645 Crew processes surveyed fish

-1700 Semotilus lunbeae - lateral line scales: 46

1700-1710 Demot dorsal fin rays: 9

Water Quality

Temp (°C): 16.76

pH: 4.78

Cond (µmS/cm): 0.020

Turb (NTU): 6.6

DO (mg/L): 10.08

TDS (g/L): 0.015

Flow (m³/s): 0.25

Herps observed: green frog

4/7/2012

0815 - Crew meets at site and gears up

Conduct tailgate HES meeting

Crew: DJB, EAU, JCV, MAF

AGS - John & Joseph Alderman

0830 Mobilize to LRRZ and gear up - 0845

- 0930 Arrive and begin LRRZ atfd

- 1100 Crew uses 3 backpack electrofishing units and complete one pass

start: 11069 - 13270

Shock time: 6431 2029, 2042, 2201

- 1200 Crew processes fish surveyed

Water Quality

Temp (°C): 11.99

pH: 6.68

Cond (µmS/cm): 0.059

Turb (NTU): 7.5

DO (mg/L): 10.67

TDS (g/L): 0.051

Flow (m³/s): 0.52

Herps observed: green frog, brown anole
two-lined salamander, yellow-bellied slider

Rite in the Rain

4/7/2012

1230 - Crew arrives at HGMCZ

1310 Crew: DJB, EAV, JCV, John Alderman

Crew conducts survey using one electrofishing unit and completes one sample pass

Shock time: 3,958 sec

One yellow bullhead collected

Water Quality

Temp (°C): 18.45

pH: 5.09

Cond (µS/cm): 0.079

Turb (NTU): 9.5

DO (mg/L): 10.56

TDS (g/L): 0.059

Flow (m/s): 0.57

Herps: green frogs, green anole

4/7/12

1520 - Crew mobilizes to LLE2

Crew: DJB, EAV, MHF, JCV

AGS - John & Joseph Alderman

1545 - Crew uses two backpack units and completes one sample pass.

Shock time: 4,102 2,014

Crew processes surveyed fish: + 2,088

Water Quality

Temp (°C): 17.54

pH: 6.57

Cond (µS/cm): 0.080

Turb (NTU): 13.3

DO (mg/L): 11.53

TDS (g/L): 0.061

Flow (m/s): 0.41

Herps observed: two-lined salamander

Rain in the Rain

4/8/12

0740 Crew mobilizes to access point
- 0800 of ULRH

Crew: DJB, EAU, JCV, MAF

AGS - John & Joseph Alderman

Weather: low 40s, clear

Oversight: none

Conduct tailgate HBS meeting

Mobilize to ULRH

0800
- 0835

0835 - Crew uses 3 backpack knits

0935 and complete one pass { 13,270 - 15610

Shock Time: 6,486 sec { 2,555, 1591

0935 Crew processes surveyed fish

- 1015 ~~Heps~~ Heps observed: two-lined salamander

- 1015 Demob from ULRH

Water Quality

Temp (°C) : 12.98

pH : 6.93

Cond (ns/cm) : 0.066

Turb (NTU) : 8.0

DO (mg/L) : 10.76

TDS (g/L) : 0.096

Flow (m/s) : 0.26

4/9/12

1050 - Arrive at UTI access point

Crew: DJB, EAU, JCV, MAF

AGS - John & Joseph Alderman

1110 - Crew uses one backpack unit

1145 to complete one sample pass.

Shock time: 1967 sec

1145 Crew processes surveyed fish

- 1200

Water Quality

Temp (°C) : 14.32

pH : 4.32

Cond (ns/cm) : 0.020

Turb (NTU) : 2.5

DO (mg/L) : 9.39

TDS (g/L) : 0.016

Flow (m/s) : 0.21

Heps: leopard frog, green frog

Rite in the Rain



1

Bluegill (*Lepomis macrochirus*)



2

Bluehead Chub (*Nocomis leptocephalus*)

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3

Brassy Jumprock (*Moxostoma cupiscartes* or *Scartomyzon* sp.)¹



4

Creek Chub (*Semotilus lumbee*)

Note:

¹ Name unresolved.

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Creek Chubsucker (*Erimyzon oblongus*)



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Dollar Sunfish (*Lepomis marginatus*)

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Dusky Shiner (*Notropis cummingsae*)



8

Eastern Mosquitofish (*Gambusia holbrooki*)

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Flat Bullhead (*Ameiurus platycephalus*)

PHOTO NOT AVAILABLE

10

Golden Shiner (*Notemigonus crysoleucas*)

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11

Green Sunfish (*Lepomis cyanellus*)



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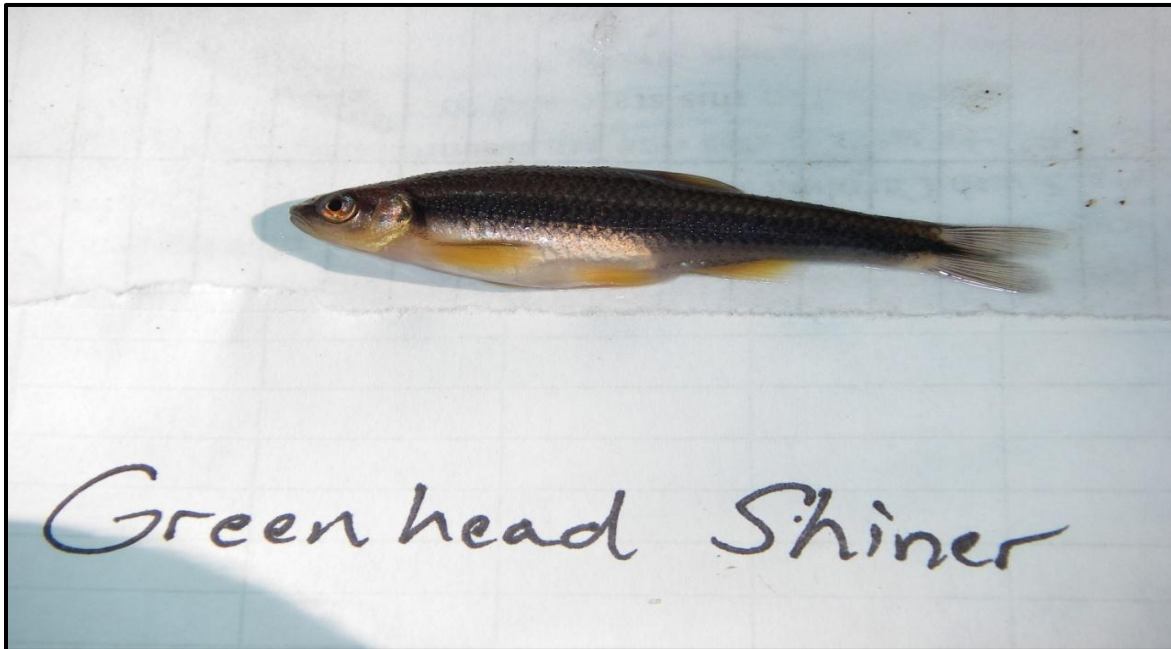
Greenfin Shiner (*Cyprinella chloristia*)

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Greenhead Shiner (*Notropis chlorocephalus*)



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Highfin Shiner (*Notropis altipinnis*)

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Largemouth Bass (*Micropterus salmoides*)



16

Margined Madtom (*Noturus insignis*)

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Mud Sunfish (*Acantharchus pomotis*)



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Piedmont Darter (*Percina crassa*)

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Pirate Perch (*Aphredoderus sayanus*)



20

Pumpkinseed (*Lepomis gibbosus*)

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21

Redbreast Sunfish (*Lepomis auritus*)



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Redfin Pickerel (*Esox americana*)

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23

Rosyside Dace (*Clinostomus funduloides*)



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Sandhills Chub (*Semotilus lumbee*)

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swallowtail
shiner



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Swallowtail Shiner (*Notropis procne*)



Tessellated Darter

26

Tessellated Darter (*Etheostoma olmstedii*)

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Yellow Bullhead (*Ameiurus natalis*)



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Yellow Perch (*Perca flavescens*)

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